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QST
OFFICIAL JOURNAL

June 20, 1986

AD HOC COMMITTEE ON AMATEUR RADIO DIGITAL COMMUNICATION

Gentlemen:

Enclosed are minutes of the Digital Committee meeting of June 21-22, 1986. Also enclosed is an updated list of Committee members and observers.

Observers, particularly, should be aware of the context of this report. The frequencies nominated in paragraph 4 represent simply the best thinking of the Digital Committee on this subject at this moment and will not be proposed for adoption at the July 1986 Board Meeting. Further consideration and coordination is required.

73,

Paul L. Rinaldo, W4RI
Chairman, Ad Hoc Committee on
Amateur Radio Digital Communication

Distribution:
Committee Members
Observers

Ad Hoc Committee on Amateur Radio Digital Communication
Newington, CT
June 14-15, 1986

MINUTES

1. The digital committee met on Saturday and Sunday, June 14-15 at ARRL headquarters. Present were:

Committee members:

Paul Rinaldo, W4RI (Chairman)
Terry Fox, WB4JFI
Lyle Johnson, WA7GXD
Phil Karn, KA9Q
Wally Linstruth, WA6JPR
Harold Price, NK6K

Observers:

Phil Anderson, WØXI (Kantronics)
Peter Eaton, WB9FLW (TAPR)
Gene Harrison, WB4NGC (Mitre)
Mike Huslig (Kantronics)
Ed Raso, WA2FTC (Gateway editor)

2. **Networking and Transport Protocols:**

Written progress reports on datagram and virtual-circuit developments by Messrs Karn and Fox are attached.

a. Mr Karn reported that his TCP/IP code written for the Xerox 820 has been successfully ported to other computers. He needs some help in porting the software and is trying to enlist some capable individuals in the Pittsburgh, PA area in this effort. Dave Mills, W3HCF, in the Washington, DC area, is currently capable of running TCP/IP but needs others to conduct on-the-air tests.

b. Mr Fox said that there are a half-dozen stations in the Washington, DC area running virtual-circuit networking software. Presently, the number of simultaneous connections is limited to about six because of memory chips installed in the TAPR TNC 2s currently in use. Mr Johnson provided information on increasing memory size, which will permit up to about 15 simultaneous connections. There are plans afoot to conduct virtual-circuit networking experiments from Woodbridge, VA up the coast to the New York City area.

c. There was a rush to develop both the datagram and virtual-circuit protocols to demonstrate them at Orlando in March, 1986, which can be considered a hard accomplishment of the packet-radio developers. The current phase of work is on-the-air testing of both protocols. Only when test results are available will the Committee be able to recommend one over the other. Thereafter, the winning protocol needs some further productizing (code purification, porting to other computers, documentation, etc) before mass distribution of a turnkey product is possible.

3. **Congestion Reduction Efforts:**

a. The Committee reconfirmed its earlier position that suitable 9600-bit/s modems are needed as soon as possible. If increasing modem speed is to have any significant impact on packet-radio congestion problems, the increase must be on the order of 8:1 over the current speed of 1200 bit/s.

b. Mr Rinaldo described his 9600-bit/s minimum-shift-keying (MSK) modem design concept. Plans are to pursue this design in the ARRL lab.

c. Some new thinking has evolved since the Committee decided on general design goals for development of 9600-bit/s modems. Earlier it was thought that the higher-speed modems would be needed primarily for intercity links. It was also throught that intracity local-area networks (LANs) would likely remain at 1200 bit/s. That is the current situation, which is dictated by the availability of 1200-baud AFSK modems and compatible FM radios, and the lack of higher-speed (RF) modems and compatible radios. However, amateur packet-radio traffic patterns tend to confirm commercial packet-switched network experience that the greater capacity is needed locally and less capacity for distant communications. This suggests that if someone comes up with a satisfactory (and affordable) 9600-bit/s modem and radio, packet users will want to use it on LANs. Because of the necessity to phase out 1200-bit/s operation and phase in 9600-bit/s operation, any 9600-bit/s modem introduced for LAN use should be capable of 1200-bit/s fallback operation.

d. In keeping with the above philosophy, the Committee developed the following new 9600-bit/s modem/radio wish list:

(1) Be suitable for both LAN and inter-LAN uses.

(2) Speed: 9600 bit/s, for compatibility with available TNCs.

(3) Bandwidth: Not to exceed 20 kHz at -26 dB.

(4) Include 1200-bit/s Bell 202 fallback capability.

(5) Be capable of 2-meter operation.

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(6) Available to users as turnkey product.

(7) Friendly to BBS environment, as many users presently see BBS operation as their primary application for packet radio.

(8) Turnaround time of less than 10 ms; the design goal should be 1 ms.

(9) Frequency stability compatible with multiple users in LAN.

(10) Radio-frequency control: Synthesizer.

(11) Interface: TAPR TNC 1 and TNC 2.

(12) Must meet FCC Part 15.

(13) RF power output: 10 watts.

Note that the Committee anticipates a market of approximately 40,000 units over the life of the modem/radios described above.

e. Dr Anderson mentioned his recent announcement of the Kantronics KCP-2400 modem (advertised on page 94 of July, 1986 QST). We noted that the KCP-2400 is based on CCITT Recommendation V.26 ter, which is correctly referred to as a "2400-bit/s" not "2400-baud" modem as it actually operates at 1200 bauds. Dibit modulation permits it to encode two bits of data in one modulation symbol.

4. Study of Packet-Radio Frequencies:

Board Minutes 45(a) (study designation of packet-radio traffic channels) and 45(h) (study recommended operating frequencies for VHF packet and HF packet radio) were discussed in great detail by the Committee. Because some of the frequencies were deterministically rather than experientially selected, the Committee requested the Chairman to contact Hank Oredson, WØRLI to vet the frequencies nominated by the Committee. This was done on June 20, and all HF channels shown below have run that gauntlet and are very close to reflecting actual on-the-air activity. Working recommendations of the Committee are as follows:

a. General:

Packet radio may be operated on any frequency where F1B emission is allowed in the FCC rules in accordance with good operating practice.

b. **2-meter Packet Frequencies:**

(1) Automatic/unattended operations should be conducted on 145.01, 145.03, 145.05, 145.07 and 145.09 MHz.

(a) 145.01 should be reserved for inter-LAN use.

(b) Use of the remaining frequencies (above) should be determined by local user groups.

(2) Additional frequencies within the 2-meter band may be designated for packet-radio use by local coordinators.

c. **HF Packet Frequencies:**

(1) **20-meter Band:**

(a) Existing Frequencies: There are currently four packet-radio frequencies in regular use, as follows:

Display (kHz)	Center (kHz)	
14103	14101.3	
14105	14103.3	
14107	14105.3	(Message forwarding)
14109	14107.3	

Notes: The "Display" column refers to the frequency displayed on the transceiver display when the transceiver mode switch is set to lower sideband (LSB), while the "Center" column indicates the actual center of the energy in the channel. Some interference to NCDXF-system beacons operating on 14100 from packet operations on 14103 has been reported. This interference appears to be from three causes: (1) excessive intermodulation products from some packet transmitters, (2) voice bandwidth receivers used by some listeners to receive the beacons, and (3) occasional off-frequency operation on the part of some packet stations using 14103.

(b) If voice-bandwidth receivers are to be protected from packet interference (a question on which the Committee takes no official position), the following frequencies are recommended:

Display (kHz)	Center (kHz)	
14105	14103.3	(Message forwarding)
14108	14106.3	
14111	14109.3	
14114	14112.3	

Notes: The lowest frequency has been moved upward to avoid interference to 14100-kHz beacons. The raster has been increased from 2 to 3 kHz in order to provide sufficient bandwidth and interchannel guard bands to permit 1200-baud operation (either under special temporary authority or an eventual rules change). This would represent 12 kHz for packet operation on this band.

(2) **40-meter Band:**

Display (kHz)	Center (kHz)	
7093	7091.3	(Message forwarding)
7096	7094.3	

Note: Nearest neighbors in the the Net Directory are: 7090 Mexican Emergency Net and 7105 Wyoming RACES Net

(3) **30-meter Band:**

Display (kHz)	Center (kHz)	
10149	10147.3	(Message forwarding)
10146	10144.3	

Note: The only Net Directory entry for 30 meters is: 10105 Pacific CW Training Net

(4) **80-meter Band:**

Display (kHz)	Center (kHz)	
3609	3607.3	(Message forwarding)
3614	3612.3	

Note: Nearest neighbors in the the Net Directory are: 3605 Buckeye Net RTTY (BRN), 3610 Eastern Pennsylvania CW Net (EPA), 3610 Kansas CW Net (QKS), and 3615 Louisiana Amateur Net (LAN).

(5) 160, 15, 12 and 10-meter Bands:

Further study is required. (There is some ongoing activity on 21105 and 21110 kHz, principally at 600 Bd, 1000-Hz shift in Region 1. It is desirable for the Committee to give some thought to 10-meter packet frequencies particularly in light of Novice Enhancement.)

d. **6-meter Packet Frequencies:**

Although 6 meters has not seen much packet-radio use thus far, there is growing interest in this band for meteor-scatter (up to 1200 miles) and beyond-line-of-sight paths over unpopulated areas with no relays where 2 meters is not practical.

(1) Although there is no reason why the 52-54 MHz range cannot be used for packet radio simplex or duplex operation if locally coordinated, the 50.6-52.0 MHz range appears to be a better place to look for packet channels. The ARRL band plan for this range is:

```
50.60 ------------
                  |
50.70 --- RTTY    |
                  |
50.80 -           |- Experimental and special
       |- R/C     |
50.98 -           |
                  |
51.00 ------------
       |- DX
51.10 -
       |- FM Simplex
52.00 -
```

(2) Analysis of the above frequencies reveals that there could be 170 kHz of prime space for packet radio in the following ranges:

50.60-50.69	90 kHz
50.71-50.79	80 kHz

However, this would not provide for duplex operation, which will be increasingly important for long-haul interLANs and meteor-scatter links. There appears to be space in the 51.1-52 MHz range for either simplex packet operation or one frequency in a duplex pair.

(3) The following are recommended candidate (channel center) frequencies to be explored with local frequency coordinators:

50.62 - 51.62
50.64 - 51.64
50.66 - 51.66
50.68 - 51.68
50.72 - 51.72
50.74 - 51.74
50.76 - 51.76
50.78 - 51.78

In addition, 51.70 could be used as a packet simplex frequency, as it cannot be paired with 50.70, which is the national RTTY frequency.

e. **220-MHz and Above:**

Further study is required.

5. **Special Temporary Authority for HF Automatic Control:**

a. Executive Committee Meeting No. 422 Minute 4.1 decided to "seek Special Temporary Authorizations for a unified network of approximately 15 packet stations to use automatic control for one year on not more than one frequency per HF band at speeds not to exceed 1200 bauds, to determine the potential for interference of such operations to amateur stations using other means of communication."

b. After considerable discussion, the Committee found it difficult to pare down the list of approximately 25 stations now acting as HF gateways to approximately 15 stations. To do so would tend to alienate those omitted. Also, packet radio is growing so rapidly that a list made now would be obsolete by the end of the STA as the real number needed by then could be up to 40, and some original stations could have dropped out. The list of stations available was one compiled by WØRLI in March. The next actions will be for the Committee Chairman to obtain a current list from WØRLI, talk to other key PBBS operators to validate the information, and work with Executive Vice President Sumner on the next practical step. (Subsequent to the meeting, WØRLI recommended contacting WA5DVV, W9ZRX, W5XO and WB7DCH.)

c. Further, the Committee confirmed that it is a good idea to include 1200-baud operation in the STA for HF automatic control. However, there are practical problems with having the right modems available at the right time during this STA. With equipment available in quantity now, 1200-baud tests can be run using Am7910 World Chip modems in CCITT V.23 (800-Hz shift nonphase-continuous FSK) mode. However, if V.23 doesn't work too well, then we still haven't produced a compelling rationale for a rule change to permit 1200-baud operation. (Of course we know that 1200-baud operation works fine on HF in ZL and VK lands, but they don't have rules that set a speed limit of 300 bauds on HF.) If 1200-baud operational feasibility is not demonstrated in the V.23 tests, then a second STA (timed according to the lead time for new modem availability) may be necessary to provide definitive 1200-baud results.

6. **Listing of Packet Repeaters:**

a. Board Minute 45(f) identified this subject for study by the Publications Committee. As the Publications Committee meeting was scheduled for the following weekend, it seemed useful to gather input from the Digital Committee.

b. The Committee feels it desirable to continue listing packet repeaters in the Repeater Directory but in a separate packet section (not mixed in with special modes). The reason for wanting it to remain there is to provide some visibility to all amateurs that packet exists, has specific active frequencies, and provides certain geographical coverage.

c. Until a Packet Directory is published by the League (which may be called for in the next year or two), the Repeater Directory should list specific digipeaters (and soon network switches). After a Packet Directory is available, specific facility listings could be dropped in favor of simply designating which frequencies are used in which areas.

d. Either for the present Repeater Directory or an eventual Packet Directory listing of specific facilities, the reporting method now in use needs modification. In general, frequency coordinators designate a frequency for packet use throughout their area and delegate the implementation to packet users (sometimes called network coordinating agents or NCAs). In many cases, the coordinators do not know all the digipeaters using (say) 145.01 MHz and do not keep book on them to the degree they do voice FM repeaters. Further, most coordinators do not report on specific digipeaters to the Repeater Directory editor, making it difficult under the present scheme to have complete and accurate information to publish. It appears that the coordinators fulfill their roles without reporting on the detail of digipeaters and that to ask them do so would be an unnecessary imposition. Rather, it appears desirable to ask the packet users to report specific digipeaters and switches to HQ.

e. The Committee also recognizes that the growth and change in packet radio is such that a paper directory is of only limited value. As soon as a network layer is in place, a machine-readable (probably on-line) directory of network facilities and users will be inevitable.

7. **GLB Electronics Proposals:**

a. GLB proposed addition of a number of features to the AX.25 link-layer protocol to provide for features introduced by specific manufacturers. GLB asked that we assign codes in the protocol identifier (PID) for this purpose. The Committee was sympathetic to the need to accommodate such data but felt that the PID was inappropriate. Instead, the Committee decided that an XID frame would be the appropriate way to implement these features.

b. As the addition of an XID frame would introduce some incompatibility with AX.25 Version 2.0, it should be held until time for a major update of the protocol. Such a change would not be undertaken lightly as there are now approximately 18,000 users who would need to change PROMs for Version 3.0.

c. In that a few minor improvements to Version 2.0 already have been identified and more could be forthcoming, the Committee agreed to solicit additional inputs from AX.25 implementers for Committee consideration in an eventual Version 3.0 for Board approval.

8. **Briefing on Link Establishment in Automated HF Systems:**

a. Gene Harrison gave the Committee an overview of the Mitre work commissioned by the National Communications System (NCS), to develop a Federal HF Interoperability Standard (HFIOS)(FED-STD-1045). It is an important program to develop automatic-linking features that, once approved, will be required in virtually all HF radios procured by the Federal Government. The driving forces are: (1) the need to revitalize HF facilities because of the vulnerability of satellites, (2) the lack of qualified radio operators, and (3) the lack of interoperability among the HF automatic-linking radios now being manufactured.

b. The primary interest of the Committee in the Mitre work is that it provides a model for automatic linking of HF packet-radio stations. Present packet HF stations stay on one frequency (usually 20 meters) while it works to some degree and either manually QRT or change to another band when the 20-meter band is dead. Failure to change bands, (1) when band conditions change or (2) to work stations via various propagational paths requiring different frequencies, causes retries and adds to congestion. Were we to adopt the approach proposed by Mitre, all this could occur automatically. In the broadest sense, Mitre proposes that radios be (1) computer controllable, (2) have a common, robust modem for exchange of linking information, and (3) do everything else in software. It would appear that this is well within the realm of practicality for amateurs using computer-controllable radios currently being marketed by Amateur Radio manufacturers.

c. Another possible application for the Mitre proposal would be amateur HF beacons such as those presently operated on 14100 kHz under the NCDXF scheme or those around 28200 kHz that could be impacted by the Novice Enhancement rule changes. The Mitre proposal has both sounding and polling protocols that could speed up the transmissions, accommodate more beacons sharing the same frequency, and permit automatic reception and data reduction.

d. Mr Harrison provided Mr Rinaldo with a complete set of briefing aids detailing the proposed HFIOS program and protocols. He also agreed to send copies directly to those on the Committee who specifically requested them on the basis that they not be reproduced and disseminated further. It isn't that the program is classified in any way; simply it is his way of controlling copies detailing protocols subject to revision as they wend their way through the approval process.

9. **Part 97 Changes Needed to Accommodate New Technology:**

a. Mr Price reported that there was growing interest in making changes to Part 97 of the FCC rules to permit new types of transmission. One group wanting changes (N2DSY, AD7I, W2JUP, WB2KMY, KB2M, AI2Q, WA2UPK, WB2VUK, W2VY and K3ZJJ) operates under the aegis of the Tri-State Repeater Council. Another group pushing multiplex (F8E) operation is the Southern California Repeater and Remote Base Association (SCRBBA). There are also some interested in permitting digital transmission of voice, SSTV and FAX in the HF bands.

b. At the Dayton HamVention, Special Services Division Chief Ray Kowalski, in conversations with Messrs Price and Mendelsohn, reportedly encouraged them (TAPR and TSARC) to submit petitions for rule changes of this type. Subsequent conversations involving TAPR, TSARC and the Digital Committee have persuaded the key players to work together through the League rather than go separate ways.

c. Mr Price presented the case for regulating emissions within the Amateur Radio Service by bandwidth rather than emission designations. This, of course, was the main thrust of the famous Docket 20777, which failed. The Committee felt that the reason for 20777's failure was that it was incorrectly done in such a way as to scare people into thinking that RTTY would be invading the "phone" bands and various other horrors. Mr Price contends that the switch from emission designators to bandwidth limitations can be accomplished without an impact on where various modes are being operated today, yet clear the way for new digital modes to be phased in.

d. Mr Rinaldo reviewed the League's informal attempts to eliminate the technical inconsistencies and oversights in the emission designators in Part 97. The message received in the FCC Report and Order on PR Docket 85-105 was that the Private Radio Bureau (PRB) did not "ACK" our suggested changes because no formal petition had been filed. The first attempt was to name every and all possible emission designators that could be used; the PRB thought that was far too detailed. The second attempt was to simplify the presentation by specifying emissions in words such as "Morse." The informal reaction from the PRB was they felt no compelling need to regulate the modes within the ham bands (except that their mail from amateurs urges them to).

e. It was agreed that if this approach was to have any chance of success, it would have to be done right the first time. The Committee agreed that Mr Price will prepare a draft of a "privilege-neutral" proposed change to Part 97 that will specify bandwidth instead of emissions. Once the draft is felt to be technically sound and defensible, it will be reported to the Board and/or Executive Committee.

10. **Digital Communications Growth at the Entry Level:**

a. The Committee discussed the desirability of a "digital license," and as shocking as this might seem to some, generally favors having such a license class sometime in the future. The Committee is also mindful of the difficulty of coming up with the right formula and selling it to the general amateur population.

b. In terms of what is practical in the near future, the Committee agreed that the Novice Enhancement effort by the League is in the right direction and deserves the active support of the digital groups.

11. **Next Meeting:** The time and place of the next Digital Committee meeting was not set and will be discussed with Board Liaison Tod Olson. Messrs Price and Linstruth reported on efforts to identify another event in Southern California to which we could attach the Sixth ARRL Amateur Radio Computer Networking Conference. Briefly, discussions with Director Heyn did not result in identifying an event in the early part of the year. Messrs Price and Linstruth will try again, this time focusing on the Southwestern Division Convention.

Respectfully submitted,

Paul L. Rinaldo, W4RI
Chairman

Posted: Sat Mar 15, 1986 2:17 AM GMT Msg: HGIG-2422-4440
From: PKARN
To: prinaldo
Subj: Summary of my protocol implementation activities
KA9Q protocol implementation summary

At present, the following protocol modules have been implemented in C and are up and running on the Xerox 820 as well as several other CPU types. All except SLIP are official ARPA/DoD standards.

Link Layer --

Serial Line IP (SLIP) - a very simple technique for sending Internet Datagrams across ordinary asynchronous lines (e.g., modems). Only function is to delimit datagrams with framing characters, which are "byte stuffed" for transparency. No error checking is provided; the checksums that are part of IP, TCP and UDP are relied on for this. SLIP is popular on UNIX systems that support TCP/IP, so this represented the easiest way to get my package up and talking with other Internet sites. It also allows the use of existing AX.25 TNCs without modifying the latter, although this is should only be done as a stopgap measure until an HDLC link level driver can be integrated directly into the package.

Network Layer --

Internet Protocol (IP) - A datagram-oriented protocol designed to operate atop an arbitrary concatenation of "subnetworks" or links which may be of widely differing designs. This module also includes the Internet Control Message Protocol (ICMP), a mandatory part of IP that reports errors in the processing of datagrams back to the sender. The IP options Loose Source Routing, Strict Source Routing and Record Route are supported; Stream ID, Security and Timestamp are ignored. (Few, if any, IP options are used extensively in the ARPA Internet). The IP module includes a routing (packet switching) facility; currently this consists of a table containing a list of host-specific destinations along with a "default" entry that may be used when the desired destination is not found in the table. No protocol is yet provided to actually manage the table; currently it must be done manually, either locally or remotely. ICMP supports all options except ICMP Timestamps.

Transport Layer --

Transmission Control Protocol (TCP) - Provides reliable, sequenced service on an end-to-end basis atop IP for those applications requiring "virtual circuit" service. The implementation supports an arbitrary number of simultaneous connections, limited only by memory space for control blocks. The Maximum Segment Size option is understood when it is received, although there is currently no way to generate it. Similarly, there is currently no provision for sending URGent data. The latest recommendations on "tinygram" avoidance are implemented and work quite well.

User Datagram Protocol (UDP) - an alternative to TCP that adds only port demultiplexing and data checksums to the raw service offered by IP; this is used by applications that prefer a datagram-oriented facility rather than the virtual circuit facility of TCP.

Presentation Layer --

Telnet - Supports a "network virtual terminal" with the ability to negotiate "options" such as remote echoing (the only significant option implemented).

File Transfer Protocol (FTP) - A rudimentary client half has been implemented as part of a Telnet user program, allowing the user to "get" or "put" files in either ASCII or binary mode with a remote server. An FTP server is currently being written.

Simple Mail Transfer Protocol (SMTP) - A "bare bones" server half has been written and is working. It collects incoming mail on a TCP connection and appends it to local mailbox files. Mail forwarding at this level is NOT currently supported, since this accounts for most of the complexity in other mail systems.

Application Layer --

The main user program that is now operational is User Telnet, which also supports simple FTP facilities as described above. A Server program that simultaneously supports a variety of facilities is in test on the PC and will be "ported" to the 820 soon. The package allows multiple simultaneous applications, each supporting multiple simultaneous users, each using TCP and/or UDP. The only limit is memory space, which is getting quite tight on the 820; the C compiler for the IBM PC seems to generate much more compact code (typically 1/2 as large as for the Z-80) so the PC seems more promising as a large-scale server.

Current activities --

The next major step is to add an HDLC driver (for both the 820's SIO and the FADCA 8530 add-on) to the list of "subnet" interfaces available to IP. Several flavors will be available: one that operates on a half duplex channel will encapsulate IP datagrams in AX.25 UI (raw datagram) frames. It will also serve as the basis for experimentation with the "ACK-ACK" protocol described in the conference paper by WB6RQN and myself. Another, simpler version will be configured to operate over a full duplex synchronous channel such as that provided by the Maryland-California satellite link which has been offered by M/A-Com to the amateur packet community on a part-time basis.

I do NOT intend to integrate a full-blown, connection-oriented AX.25 Level 2 package into my IP code. As I have often stated elsewhere, AX.25 Level 2 has many unnecessary features that don't belong in the link layer, making it needlessly complex and difficult to use for the simple job of relaying IP datagrams. The modules that make up the User Telnet program (SLIP, IP, TCP, UDP, Telnet, FTP) come to a total of 42K on the 820. My older AX.25 Level Two package alone is over 30 K; clearly it wouldn't fit on the 820 anyway. If someone else wants to do this, or to provide a "transport layer bridge" between AX.25 and TCP, I certainly won't stop him/her, but I am not personally interested in working on short term stopgaps.

Phil Karn

Virtual Circuit Update

Terry Fox, WB4JFI
President, AMRAD

Orlando, Forida Demonstration

As part of the Fifth ARRL Computer Networking Convention held in Orlando, Florida both networking camps were asked to put on a demonstration. The Virtual Circuit group brought several TAPR TNC 2's and TNC 2 clones, each with a prototype version of AX.25/AX.75 networking code in addition to the standard TNC-2 packet code. Of the six TNC-2s brought down, five were used in the demonstration, and one was left in a hotel room for individual use. All five TNC-2s were connected to a different computer AND A DIFFERENT RADIO. The only communications path between the TNC's was via two meter radios, assuring an accurate simulation of real-world operation.

Each TNC 2 was capable of operating as an individual packet station and/or as a packet switch. This packet switch operates much like a digipeater for a local-area network except it maintains individual connections between each packet station operating through it. This means that errors are corrected by the switch rather than by the end-users.

Demonstrations of the several modes of AX.25/AX.75 packet switch operation were performed. In addition to the switch and network software, each TNC-2 also contains a non-level 3, or "PAD" interface. This interface allows packet stations running only the AX.25 layer 2 protocol (no network capability) to interface into the network via the PAD and network switch. As part of the demonstrations given, network operation showing how two network-capable users operating through the switch was shown, along with a network-capable user talking to a non-network-capable user operating through the PAD, and lastly two non-network-capable users operating through the switch and PAD interface was also demonstrated.

A short discussion was then held regarding routing and routing tables. The addressing mechanism used by the network code in the TNC 2's is AX.121. This involves the use of telephone system-like numbers. In fact the demonstration was carried out using the phone numbers of the packet stations involved. The routing tables in the packet switches demonstrated are entered by the switch operator from the local console. No intelligent routing or table updating is done by this method, however wildcards are permitted. This means one entry in the table, such as 0310070*, N2DSY-4 will route all connections for Northern Virginia through the indicated switch (N2DSY-4). While this is crude, it works. More work will be done in the future on routing methods, as the network develops.

A discussion was also held on the merits of Z80 vs 8088 type computers for development. It appears that there will be an

effort by members of the Virtual Circuit group to work in both areas. Some are continuing to develop Network and Transport code for Z80-based computers, such as the TAPR TNC-2, Xerox 820, and TAPR NNC. Others are starting to develop Network code for the IBM PC type computers.

It is important to realize that ALL the software to run the standard TAPR TNC-2 terminal interface, the standard AX.25 Level 2 protocol, the AX.25/AX.75 Network protocol, the Network switch, AND the user PAD interface fit nicely into a standard Rev. 2 TAPR TNC 2, using one 27256 EPROM (32k) and two 6264 RAM chips, for a total of 16k of RAM. This small RAM size does lead to some limitations. For instance, only five stations can connect to the switch. Also, there is only room for about twenty entries in the routing tables. In addition, a fast terminal should be used, otherwise buffers get held up in terminal processing, and are not available for packet operation.

Howie Goldstein, N2WX, wrote the software described above and he deserves a lot of credit for putting so much into the TNC 2. I feel the Network code in the TNC 2 is just about ready to give to the general packet public. The switch is going to take more time, however. There is just not enough memory on a TNC 2 to support a real packet switch. Howie is working on this, and should have something running before too long.

Some EPROMs containing the VC Networking code were handed out at Orlando to hams from other areas to test. In addition, the code is available on the AMRAD phone-line bulletin board (703-734-1387). It can be found in the TNC 2 file section. In addition, documentation on how to operate the VC code will be on the bulletin board shortly.

Progress since Orlando

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In addition, we are working on a switch project that is being developed by many of our members, each working on a portion of the total switch. We are meeting weekly, and passing information back and forth via the AMRAD bulletin board. We hope to have a complete packet switch running on a PC before fall.

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RADIO DIGITAL COMMUNICATION
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Ad Hoc Committee on Amateur Radio Digital Communication
Newington, CT
June 14-15, 1986

AGENDA

1. Progress reports on development of networking and transport protocols.

2. Progress reports on congestion reduction efforts, particularly higher-speed modems.

3. Board Minute 45(a) -- Study designation of packet-radio traffic channels (Action: Membership Services Committee in coordination with Digital Committee) -- and -- Board Minute 45(h) -- Study recommended operating frequencies for VHF packet and HF packet radio (Action: Membership Services Committee in coordination with Digital Committee)

4. Executive Committee Meeting No. 422 Minute 4.1 -- "seek Special Temporary Authorizations for a unified network of approximately 15 packet stations to use automatic control for one year on not more than one frequency per HF band at speeds not to exceed 1200 bauds, to determine the potential for interference of such operations to amateur stations using other means of communication."

5. Board Minute 45(f) -- Study directory listings for packet stations (Action: Publications Committee)

6. GLB Electronics proposals for special AX.25 protocol identifiers. (Correspondence from Gil Boelke, W2EUP)

7. Link establishment in automated HF systems. (Gene Harrison, WB4NGC)

8. Progress on Jack Sanders, NC4E, message-transfer protocol evaluation. (Wally Linstruth, WA6JPR)

9. Define single bit in IP addressing structure for USA-FCC/Non-USA addressing. (Wally Linstruth, WA7JPR)

10. Recent activities creating a test bed to implement a broad spectrum of technologies leading to real networking. (Wally Linstruth, WA7JPR)

11. Looking ahead to Part 97 changes needed to accommodate new digital technologies. (Harold Price, NK6K, et al)

12. Packet-radio articles and columns.

Meeting Minutes
Ad Hoc Committee on Amateur Radio Digital Communication
Orlando, Florida
March 8-9, 1983

1) The Ad Hoc Committee on Amateur Radio Digital Communication met in Orlando, FL on March 8 to discuss current packet-radio issues. Present were:

Paul Rinaldo, W4RI, Chairman
Marshall Quiat, AGØX, Alternate Board Liaison
Terry Fox, WB4JFI
Lyle Johnson, WA7GXD
Phil Karn, KA9Q
Wally Linstruth, WA6JPR
Doug Lockhart, VE7APU
Hank Magnuski, KA6M
Harold Price, NK6K

2) FCC PR Docket 85-105 Report and Order

The discussion opened with a synopsis of the situation by Paul Rinaldo. He pointed out that, as written, the restrictions specified in the Report and Order apply to all amateur operations, not just digital modes. Twenty Petitions for Reconsideration have been filed with the FCC.

A primary concern of the Commission is undetected use of the amateur packet-radio network by commercial interests. Harold Price expressed a fear that, since the subject of an audit trail was introduced by the League, the Commission may decide to require such a record for network monitoring. Mr. Rinaldo replied that in talks with the Commission, the point was made that this kind of monitoring would occur without need of a specific FCC-imposed requirement.

President Price, Executive Vice President Sumner and Washington Area Coordinator Williams visited the Commission on February 27 to discuss the subject. The next day, the League filed a Petition for Extraordinary Relief for packet radio above 50 MHz using AX.25 protocol. Harold Price asked whether or not specification of a protocol set a bad precedent. Mr. Lockhart wondered how this affected the users of Vancouver protocols. Mr. Rinaldo said that the FCC had recommended that the petition for relief be as specific as possible and not ask for more than we need to continue operation of the packet-radio network. In addition, specifying AX.25 in the petition would preempt any possible Field Operations Bureau objection that they would be unable to monitor transmissions.

Mr. Fox asked whether or not V-2 could be considered an AX.25-compatible protocol for the purposes of this petition. Mr Quiat recommended against asking the FCC for an interpretation of that question. Mr. Price reminded the Committee that the Commission's expressed concern was with monitoring of amateur packet transmissions, which would be problematic with regard to V-2. Mr. Rinaldo pointed out that it was a practical concern that the FOB be able to (a) read the transmissions and (b) identify the stations in communication, using off-the-shelf TNCs they could buy. Not many TNCs support V-2 (in addition to AX.25) anymore, and it is not possible for FOB to identify the stations as V-2 does not include call signs in the frame header; virtually no one is using CW IDs any more. Mr. Price suggested that the League publish that it was not the League's intent to have the FCC write AX.25 into the permanent rules.

Dr. Magnuski asked whether, in light of the questions of the definition of third-party traffic raised by this action, the Commission should attempt to define by example what is, and what is not, third-party traffic. Mr. Rinaldo replied that, besides being a difficult thing to do, it would be better not to ask the FCC at this time.

2) Congestion Reduction

Mr. Rinaldo reminded the Committee that this subject was discussed at the previous Committee meeting. At the January ARRL Board Meeting, a motion was made that the Digital, VHF/UHF and Membership Services Committees study the existing band plans with an eye toward increasing the spectrum available for packet-radio operation. The Committee members were requested to write to the Chairman with their recommendations, which will be used to draw up recommendations to be forwarded to the other Committees and subsequently to the Board.

Mr. Fox pointed out that the frequencies specified in his paper for the 5th Computer Networking Conference were drawn from discussions with The Middle Atlantic Repeater Council (TMARC). Some of these frequencies were subsequently coordinated for other users. Mr. Linstruth said that frequency coordination was always left to the local coordinators. Mr. Rinaldo replied that we need at least a packet-radio band plan. Mr. Fox asked why not simply state that the available frequencies need to be better utilized. Mr. Price said he thought that the available frequencies are sufficient with proper user education. Mr. Rinaldo asked if that meant that the current 145.0-145.1 MHz band is sufficient. Mr. Johnson pointed out that the use of full-duplex systems was not addressed by specifying that narrow range of frequencies. Mr. Rinaldo replied that the Committee should make it clear that the existing full-duplex repeater pairs may be coordinated for packet use.

Mr. Price suggested that QST articles would help to educate users about frequency usage. Mr. Johnson volunteered to write such an article. Dr. Magnuski pointed out that a capability to monitor the network is essential if the problem is going to be clearly defined, and part of the problem was improper adjustment of equipment, which includes modulation levels and TNC parameters. Mr. Rinaldo wondered if an activity analogous to the "FM clinic" that used to be popular at hamfests would help solve the problem. General approval of that concept was expressed by the Committee. Mr. Price expressed a need for training aids and suggested that the Committee generate a list of such aids for use by local clubs.

In the area of higher-speed packet-radio hardware, Mr. Rinaldo noted that the Committee cannot dictate solutions to industry. Mr. Price stated that the Committee could, however, aid manufacturers by advising them on the market demand for devices. Mr. Rinaldo added that amateurs, particularly TAPR, have already removed some of the risk in manufacturing packet equipment by offering proven designs. By extension, this could be carried over into high-speed modems.

Mr. Rinaldo recapped modem discussions at the Committee's last meeting. Cleary, 9600-bit/s modems are needed. Equally clear is that even higher speeds, eg 56 kbit/s, will be needed soon. While current TNCs will support 9600 bit/s, TNC development will be needed, and must parallel the development of 56-kbit/s modems.

On a related topic, Dr. Magnuski reported on some developments in 9600-bit/s modems that make use of voice-grade channels. Current Rockwell chip sets are priced at $270, but there may be a substantial drop to the $50-100 price range when the modems are integrated into a single chip. Mr. Karn pointed out that this kind of 9600-bit/s scheme would have the advantage of working with an unmodified FM voice radio. Dr. Magnuski will keep the Committee advised of price changes and results of on-air tests.

3) Networking and Transport Protocols

Mr. Karn reported on his Xerox 820 implementation of the ARPANET Internet Protocol Suite, which includes Internet Protocol (IP) with all options, Transport Control Protocol (TCP), User Datagram Protocol (UDP) and a rudimentary Field Transfer Protocol (FTP).

Mr. Fox reported on the implementation of a virtual-circuit networking protocol using a TAPR TNC 2 (or clone) by Howie Goldstein, N2WX.

(Both the datagram and virtual-circuit network-level protocols were demonstrated on March 9.)

Messrs. Karn and Fox were requested to supply more-specific progress reports on these significant developments.

4) Message Transfer Protocol

A message-transfer protocol proposed by Jack Sanders, NC4E had been given to Committee members who attended the last meeting. The the Committee acknowledged that there was some fresh interest in such a protocol for NTS traffic. Mr. Linstruth said that he has sent software to active ARES stations to evaluate and that he was interested in leading the evaluation of this protocol. (Subsequent to the meeting, Mr. Linstruth said that he would work with Mr. Sanders and David Cheek, WA5MWD, who is also interested.)

5) Next Committee Meeting

Mr. Rinaldo asked that the Committee consider a long-weekend meeting in Newington prior to the next Board Meeting. After discussion, the weekend of June 14-16 was selected.

6) Sixth Computer Networking Conference

Conferences 1-5 were:

October 16-17, 1981	Gaithersburg, MD
March 19, 1983	San Francisco, CA
April 15, 1984	Trenton, NJ
March 30, 1985	San Francisco, CA
March 9, 1986	Orlando, FL

Since these Computer Networking Conferences were started, there has been general agreement that they should alternate between the eastern and western parts of the country in order that packeteers would have easy access to at least every other one. In the past, there has always been a hosting organization willing to make the invitation and arrange for local logistics. Also, we have scheduled the Conferences in conjunction with Amateur Radio or computer conventions.

Messrs. Price and Linstruth invited the Committee to consider Southern California as the site of the Sixth Computer Networking Conference sometime in 1987. They will investigate the conventions being held and make a specific invitation after consultation with Southwestern Division Director Heyn.

6) International Issues

Mr. Rinaldo addressed the Committee regarding the need to coordinate with other IARU societies. Those societies already active in packet-radio matters are experiencing problems reconciling existing rules with the potentials of packet radio. Third-party restrictions may prove to be particularly troublesome

in development of international routes. Since the new Board Liaison to the Committee, Tod Olson, is also the ARRL International Affairs Vice President, he has asked for specific recommendations for discussions with other societies. Committee members are requested to contact the Chairman with suggestions.

Jeff Ward, GØ/K8KA, an observer at the meeting, reported on the regulatory problems with packet radio in the UK. In brief, they are: (a) repeaters are strictly controlled in the UK, and there is no allowance for digipeaters; (b) amateur-to-amateur traffic is allowed, but point-to-multipoint transmissions fall under the UK definition of impermissible broadcasting; (c) no 2-meter frequencies are available for packet, and all higher-frequency bands are shared with other services. On the brighter side, interest is high, and meetings are being held to resolve the problems.

7) Data Network Identification Code

Mr. Fox suggested that the League request the FCC to issue a Data Network Identification Code (DNIC) to the Amateur Radio Service. Mr. Rinaldo agreed to raise the question with Perry Williams to research the possibility.

8) Automatic Operation on HF

Mr. Price reported that HF packet traffic was considerably less than it had been because of recent FCC actions. HF station operators are (in accordance with the present rules) taking their stations off the air when not attended. This results in an insufficient number of stations to connect the network at any one time, except perhaps evenings and weekends when most people are off work. He recommended that rule-making action is needed to legalize unattended operation of HF packet stations.

Mr. Karn wondered if a Special Temporary Authority (STA) would serve the purpose for a small number of stations.

(Subsequent to the meeting, Mr. Sumner drafted a paper on an STA approach for possible consideration of the Executive Committee on March 14.)

9) Closing Remarks

Mr. Rinaldo expressed the Committee's appreciation to the people who have worked so hard getting networking-protocol implementations ready for demonstration at the Computer Networking Conference [applause]. He also thanked Gwyn Reedy, W1BEL, and Dick Jansson, WD4FAB, of FADCA, who organized the meeting and Conference [applause]. Jeff Ward rose from the observers' gallery to thank Mr. Quiat for his service as Board Liaison to the Committee [applause].

10) Fifth Amateur Radio Computer Networking Conference

The following day, the Fifth Amateur Radio Computer Networking Conference was held. This event was hosted by the Florida Amateur Digital Communications Association (FADCA). The Conference was held in a room provided in the Expo Centre as part of the Orlando Hamcation and Computer Show. Twenty six technical papers were preprinted in the conference proceedings, which ran 123 pages. Most authors made oral presentations at the conference. We were pleased that Fujio Yamashita, JS1UKR, came from the JARL to personally present his paper. Attendance at any one time was around 75, and interest remained high throughout the day.

Respectfully submitted,

Paul L. Rinaldo, W4RI
Chairman

Posted: Sat Mar 15, 1986 2:17 AM GMT
From: PKARN
To: prinaldo
Subj: Summary of my protocol implementation activities
Msg: HGIG-2422-4440

KA9Q protocol implementation summary

At present, the following protocol modules have been implemented in C and are up and running on the Xerox 820 as well as several other CPU types. All except SLIP are official ARPA/DoD standards.

Link Layer --

Serial Line IP (SLIP) - a very simple technique for sending Internet Datagrams across ordinary asynchronous lines (e.g., modems). Only function is to delimit datagrams with framing characters, which are "byte stuffed" for transparency. No error checking is provided; the checksums that are part of IP, TCP and UDP are relied on for this. SLIP is popular on UNIX systems that support TCP/IP, so this represented the easiest way to get my package up and talking with other Internet sites. It also allows the use of existing AX.25 TNCs without modifying the latter, although this is should only be done as a stopgap measure until an HDLC link level driver can be integrated directly into the package.

Network Layer --

Internet Protocol (IP) - A datagram-oriented protocol designed to operate atop an arbitrary concatenation of "subnetworks" or links which may be of widely differing designs. This module also includes the Internet Control Message Protocol (ICMP), a mandatory part of IP that reports errors in the processing of datagrams back to the sender. The IP options Loose Source Routing, Strict Source Routing and Record Route are supported; Stream ID, Security and Timestamp are ignored. (Few, if any, IP options are used extensively in the ARPA Internet). The IP module includes a routing (packet switching) facility; currently this consists of a table containing a list of host-specific destinations along with a "default" entry that may be used when the desired destination is not found in the table. No protocol is yet provided to actually manage the table; currently it must be done manually, either locally or remotely. ICMP supports all options except ICMP Timestamps.

Transport Layer --

Transmission Control Protocol (TCP) - Provides reliable, sequenced service on an end-to-end basis atop IP for those applications requiring "virtual circuit" service. The implementation supports an arbitrary number of simultaneous connections, limited only by memory space for control blocks. The Maximum Segment Size option is understood when it is received, although there is currently no way to generate it. Similarly, there is currently no provision for sending URGent data. The latest recommendations on "tinygram" avoidance are implemented and work quite well.

User Datagram Protocol (UDP) - an alternative to TCP that adds only port demultiplexing and data checksums to the raw service offered by IP; this is used by applications that prefer a datagram-oriented facility rather than the virtual circuit facility of TCP.

Presentation Layer --

Telnet - Supports a "network virtual terminal" with the ability to negotiate "options" such as remote echoing (the only significant option implemented).

File Transfer Protocol (FTP) - A rudimentary client half has been implemented as part of a Telnet user program, allowing the user to "get" or "put" files in either ASCII or binary mode with a remote server. An FTP server is currently being written.

Simple Mail Transfer Protocol (SMTP) - A "bare bones" server half has been written and is working. It collects incoming mail on a TCP connection and appends it to local mailbox files. Mail forwarding at this level is NOT currently supported, since this accounts for most of the complexity in other mail systems.

Application Layer --

The main user program that is now operational is User Telnet, which also supports simple FTP facilities as described above. A Server program that simultaneously supports a variety of facilities is in test on the PC and will be "ported" to the 820 soon. The package allows multiple simultaneous applications, each supporting multiple simultaneous users, each using TCP and/or UDP. The only limit is memory space, which is getting quite tight on the 820; the C compiler for the IBM PC seems to generate much more compact code (typically 1/2 as large as for the Z-80) so the PC seems more promising as a large-scale server.

Current activities --

The next major step is to add an HDLC driver (for both the 820's SIO and the FADCA 8530 add-on) to the list of "subnet" interfaces available to IP. Several flavors will be available: one that operates on a half duplex channel will encapsulate IP datagrams in AX.25 UI (raw datagram) frames. It will also serve as the basis for experimentation with the "ACK-ACK" protocol described in the conference paper by WB6RQN and myself. Another, simpler version will be configured to operate over a full duplex synchronous channel such as that provided by the Maryland-California satellite link which has been offered by M/A-Com to the amateur packet community on a part-time basis.

I do NOT intend to integrate a full-blown, connection-oriented AX.25 Level 2 package into my IP code. As I have often stated elsewhere, AX.25 Level 2 has many unnecessary features that don't belong in the link layer, making it needlessly complex and difficult to use for the simple job of relaying IP datagrams. The modules that make up the User Telnet program (SLIP, IP, TCP, UDP, Telnet, FTP) come to a total of 42K on the 820. My older AX.25 Level Two package alone is over 30 K; clearly it wouldn't fit on the 820 anyway. If someone else wants to do this, or to provide a "transport layer bridge" between AX.25 and TCP, I certainly won't stop him/her, but I am not personally interested in working on short term stopgaps.

Phil Karn

Virtual Circuit Update

Terry Fox, WB4JFI
President, AMRAD

Orlando, Forida Demonstration

As part of the Fifth ARRL Computer Networking Convention held in Orlando, Florida both networking camps were asked to put on a demonstration. The Virtual Circuit group brought several TAPR TNC-2's and TNC-2 clones, each with a prototype version of AX.25/AX.75 networking code in addition to the standard TNC-2 packet code. Of the six TNC-2s brought down, five were used in the demonstration, and one was left in a hotel room for individual use. All five TNC-2s were connected to a different computer AND A DIFFERENT RADIO. The only communications path between the TNC's was via two meter radios, assuring an accurate simulation of real-world operation.

Each TNC-2 was capable of operating as an individual packet station and/or as a packet switch. This packet switch operates much like a digipeater for a local-area-network except it maintains individual connections between each packet station operating through it. This means that errors are corrected by the switch rather than by the end-users.

Demonstrations of the several modes of AX.25/AX.75 packet switch operation were performed. In addition to the switch and network software, each TNC-2 also contains a non-level 3, or "PAD" interface. This interface allows packet stations running only the AX.25 layer 2 protocol (no network capability) to interface into the network via the PAD and network switch. As part of the demonstrations given, network operation showing how two network-capable users operating through the switch was shown, along with a network-capable user talking to a non-network-capable user operating through the PAD, and lastly two non-network-capable users operating through the switch and PAD interface was also demonstrated.

A short discussion was then held regarding routing and routing tables. The addressing mechanism used by the network code in the TNC-2's is AX.121. This involves the use of telephone system-like numbers. In fact the demonstration was carried out using the phone numbers of the packet stations involved. The routing tables in the packet switches demonstrated are entered by the switch operator from the local console. No intelligent routing or table updating is done by this method, however wildcards are permitted. This means one entry in the table, such as 03100703*, N2DSY-4 will route all connections for Northern Virginia through the indicated switch (N2DSY-4). While this is crude, it works. More work will be done in the future on routing methods, as the network develops.

A discussion was also held on the merits of Z80 vs 8088 type computers for development. It appears that there will be an

effort by members of the Virtual Circuit group to work in both areas. Some are continuing to develop Network and Transport code for Z80-based computers, such as the TAPR TNC-2, Xerox 820, and TAPR NNC. Others are starting to develop Network code for the IBM-PC type computers.

It is important to realize that ALL the software to run the standard TAPR TNC-2 terminal interface, the standard AX.25 Level 2 protocol, the AX.25/AX.75 Network protocol, the Network switch, AND the user PAD interface fit nicely into a standard Rev. 2 TAPR TNC-2, using one 27256 EPROM (32k) and two 6264 RAM chips, for a total of 16k of RAM. This small RAM size does lead to some limitations. For instance, only five stations can connect to the switch. Also, there is only room for about twenty entries in the routing tables. In addition, a fast terminal should be used, otherwise buffers get held up in terminal processing, and are not available for packet operation.

Howie Goldstein, N2WX, wrote the software described above and he deserves a lot of credit for putting so much into the TNC-2. I feel the Network code in the TNC-2 is just about ready to give to the general packet public. The switch is going to take more time, however. There is just not enough memory on a TNC-2 to support a real packet switch. Howie is working on this, and should have something running before too long.

Some EPROMs containing the VC Networking code were handed out at Orlando to hams from other areas to test. In addition, the code is available on the AMRAD phone-line bulletin board (703-734-1387). It can be found in the TNC-2 file section. In addition, documentation on how to operate the VC code will be on the bulletin board shortly.

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We of AMRAD came back from Orlando recharged, especially seeing the fine operation of Virtual Circuits there. We have decided to support the IBM-PC family of computers in our further endeavers. We have already developed a new PC board that plugs into the PC buss and provides two packet channels, which will be available from PAC-COMM shortly.

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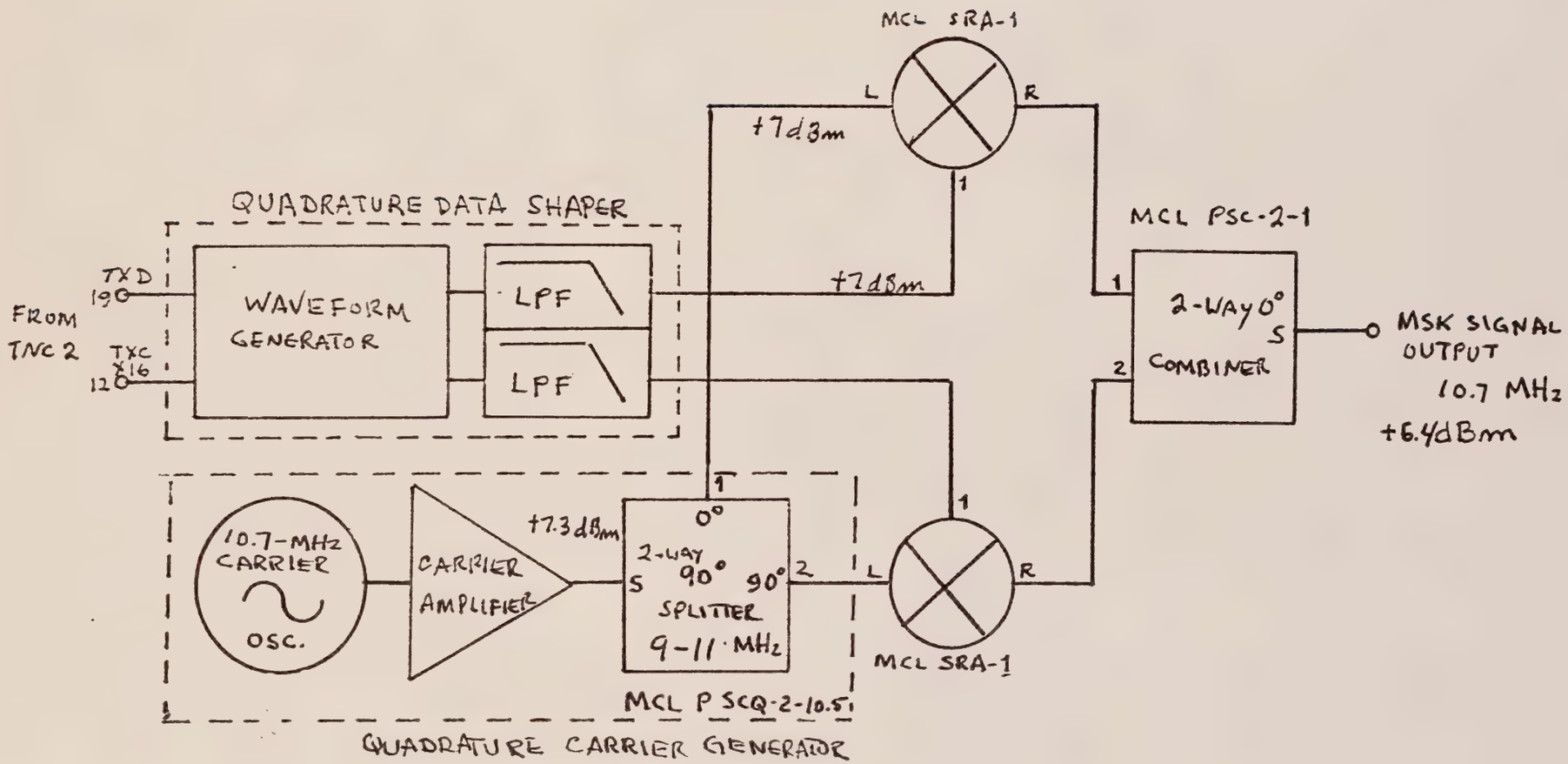
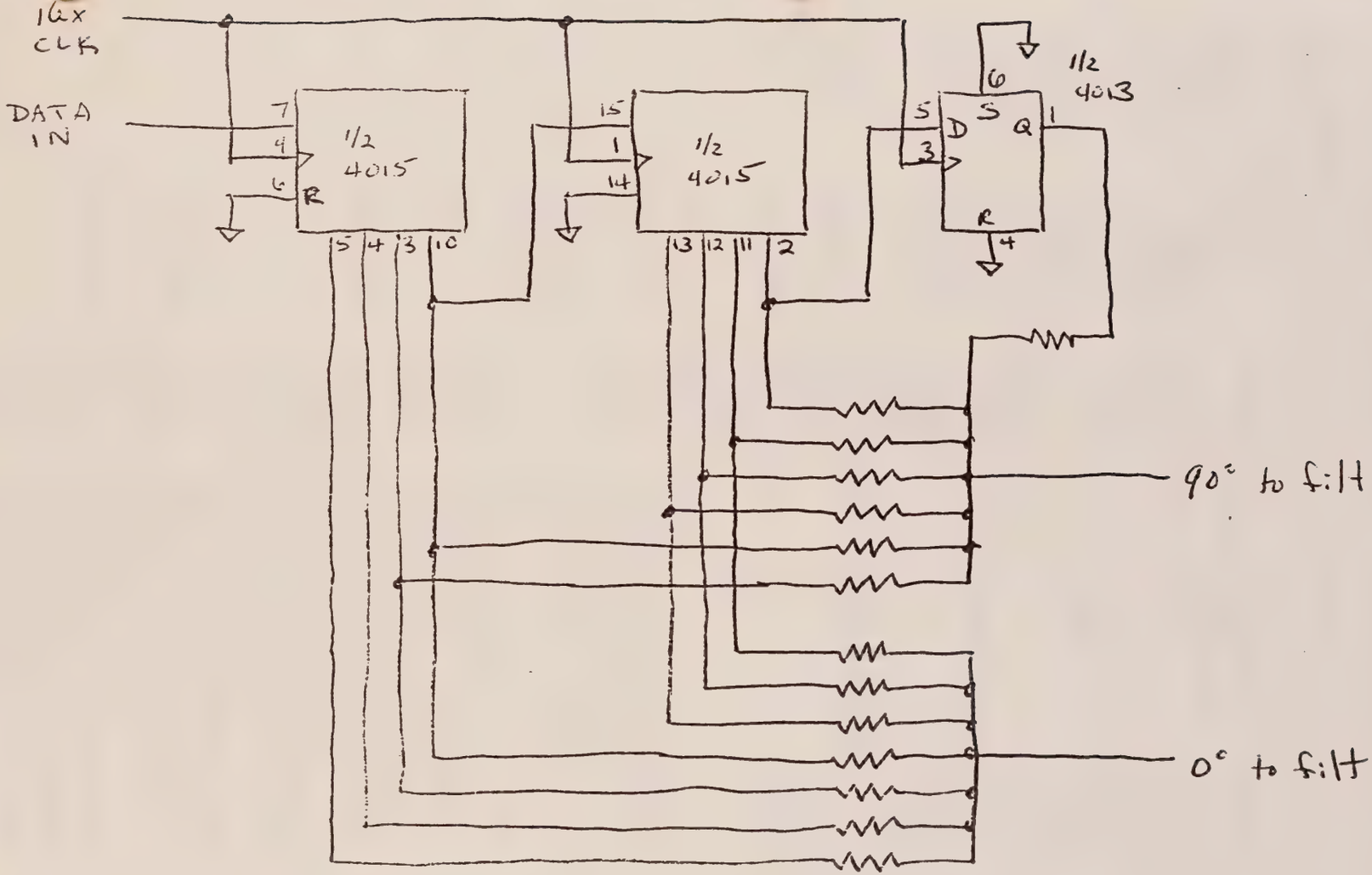
Gordon Beattie, N2DSY, has most of the CCITT X.224 Class 1 Transport Protocol for a PC, so this will also add to the PC support effort. In addition, Gordon and myself have agreed to provide both addressing methods to start out in Network operations. Gordon prefers the AX.121 addressing scheme, while I prefer the Maidenhead or gridsquare addressing. Eventually one system will be adopted, but for now we will test both.



9600-Bd MSK MODULATOR



Waveform Generator

steadily gaining popularity. This growth has been largely brought about by UHF ATV repeaters, which greatly extend the communications range of an individual ATV station. U.S. and Canadian ATV repeaters are listed in the ARRL *Repeater Directory*.

Because an FSTV signal can occupy as much as 6 MHz, only the 70 cm and higher-frequency bands are wide enough to accommodate this type of operation. Specific ATV channels are designated in the ARRL band plans, which are included in the *Repeater Directory*.

U.S. and Canadian FSTV stations generally follow Electronic Industries Association (EIA) RS-170 standard for black-and-white transmissions and National Television Standards Committee (NTSC) recommendations for color television. Amateurs are not limited to using industry standards, but their use assures the compatibility of a wide variety of commercially available TV cameras, sync generators and receiving equipment. Most home TV receivers require only a frequency converter to translate the 70- or 23-cm ATV frequencies to a normal broadcast TV channel. Some UHF-TV tuners can receive 70-cm ATV by retuning broadcast channel

Table 6

Canadian Amateur Bands*

Band (limitations)	*Frequency (MHz)*	*Emissions*
80 meters	3.500-3.725	A1, F1
(1, 3, 4, 5)	3.725-4.000	A1, A3, F3
40 meters	7.000-7.050	A1, F1
(1, 3, 4, 5)	7.050-7.100	A1, A3, F3
	7.100-7.150	A1, F1
	7.150-7.300	A1, A3, F3
30 meters	10.100-10.150	A1, F1
20 meters	14.000-14.100	A1, F1
(1, 3, 4, 5)	14.100-14.350	A1, A3, F3
15 meters	21.000-21.100	A1, F1
(1, 3, 4, 5)	21.000-21.450	A1, A3, F3
10 meters	28.000-28.100	A1, F1
(2, 3, 4, 5)	28.100-29.700	A1, A3, F3
6 meters	50.000-50.050	A1
(3, 4)	50.050-51.000	A1, A2, A3, F1, F2, F3
	51.000-54.000	A0, A1, A2, A3, A4, F1, F2, F3, F4
2 meters	144.000-144.100	A1
(3, 4)	144.100-145.500	A0, A1, A2, A3, A4, F1, F2, F3, F4
(3, 4, 7)	144.500-145.800	P0, P1, A0, A1, A2, A3, A4, F1, F2, F3, F4
(3, 4)	145.800-148.000	A0, A1, A2, A3, A4, F1, F2, F3, F4
(3, 4)	220.000-220.100	A0, A1, A2, A3, A4, F1, F2, F3, F4
(9, 10, 13, 15)	220.100-220.500	
(9, 12, 13, 15)	220.500-221.000	
(11, 13, 14, 15)	221.000-223.000	
(9, 12, 13, 15)	223.000-223.500	
(3, 4)	223.500-225.000	A0, A1, A2, A3, A4, F1, F2, F3, F4
(4, 6)	430.000-433.000	A0, A1, A2, A3, A4, A5, F1, F2, F3, F4, F5
(12, 13, 14, 15)	433.000-434.000	
(3, 4, 8)	434.000-434.500	P0, P1, P2, P3, A0, A1, A2, A3, A5, F1, F2, F3, F4, F5
(4, 6)	434.500-450.000	A0, A1, A2, A3, A4, A5, F1, F2, F3, F4, F5
	902.000-928.000	A3, F3
	1215.000-1300.000	A0, A1, A2, A3, A4, A5, F1, F2, F3, F4, F5
	2300.000-2450.000	A0, A1, A2, A3, A4, A5, F1, F2, F3, F4, F5, P0, P1, P2, P3, P4, P5, P9
	3300.000-3500.000	A0, A1, A2, A3, A4, A5, F1, F2, F3, F4, F5, P0, P1, P2, P3, P4, P5, P9
	5650.000-5925.000	A0, A1, A2, A3, A4, A5, F1, F2, F3, F4, F5, P0, P1, P2, P3, P4, P5, P9
	10,000.000-10,500.000	A0, A1, A2, A3, A4, A5, F1, F2, F3, F4, F5, P0, P1, P2, P3, P4, P5, P9
(9, 14, 15)	24,000.000-24,010.000	
	24,010.000-24,250.000	A0, A1, A2, A3, A4, A5, F1, F2, F3, F4, F5, P0, P1, P2, P3, P4, P5, P9

Limitations

1) Phone privileges are restricted to holders of advanced Amateur Radio Operators Certificates, and of Commercial Certificates.

2) Phone privileges are restricted as in footnote 1, and to holders of Amateur Radio Operators Certificates, whose certificates have been endorsed for operation on phone in these bands.

3) Amplitude modulation (A2, A3, A4) shall not exceed ± 3 kHz (6A3)

4) Frequency modulation (F2, F3, F4) shall not produce a carrier deviation exceeding ± 3 kHz, (6F3) except that in the 52-54 MHz and 144.1-148 MHz bands and higher the carrier deviation shall not exceed ± 15 kHz (30F3)

5) Slow-scan television (A5), permitted by special authorization shall not exceed a bandwidth greater than that occupied by a normal single-sideband voice transmission.

6) Television (A5), permitted by special authorization, shall employ a system of standard interlace and scanning with a bandwidth of not more than 4 MHz.

7) Pulse modulation with any mode of transmission shall not produce signals of a bandwidth exceeding 15 kHz.

8) Pulse modulation with any mode of transmission shall not produce signals of a bandwidth exceeding 30 kHz.

9) Any mode may be used.

10) Packet transmissions shall not produce signals exceeding 10 kHz.

11) Packet transmissions shall not produce signals exceeding 25 kHz.

12) Packet transmissions shall not produce signals exceeding 100 kHz.

13) Licensees performing an Amateur Experimental Service may use such modulation techniques or types of emission for packet transmission as they may select by experimentation on conditions that they do not exceed the bandwidths established in 10, 11 and 12.

14) Only packet transmissions shall be used.

15) Final RF output power used for packet transmissions shall not exceed 100 watts peak power and 10 watts average power.

Operation in frequency band 1.800-2.000 MHz shall be limited to the area as indicated in the following table and shall be limited to the indicated maximum dc power input to the anode of the final radio frequency stage of the transmitter during day and night hours respectively; for the purpose of this table "day" means the hours between sunrise and sunset, and "night" means the hours between sunset and sunrise. A1, A3 and F3 emissions are permitted.

	A	*B*	*C*	*D*	*E*	*F*	*G*	*H*
British Columbia	3'	3	3	1	0	0	0	0
Alberta	3'	3	3	3	1	0	0	1
Saskatchewan	3'	3	3	3	3	1	1	3
Manitoba	3'	2	2	2	2	2	2	3
Ontario North of 50° N.	3	1	1	1	1	0	0	2
Ontario South of 50° N.	3'	2	1	0	0	0	0	1
Province of Quebec North of 52° N.	1	0	0	1	1	0	0	2
Province of Quebec South of 52° N.	3	2	1	0	0	0	0	0
New Brunswick	3	2	1	0	0	0	0	0
Nova Scotia	3	2	1	0	0	0	0	0
Prince Edward Island	3	2	1	0	0	0	0	0
Newfoundland (Island)	3	1	1	0	0	0	0	0
Newfoundland (Labrador)	2	0	0	0	0	0	0	0
Yukon Territory	3	3	3	1	0	0	0	0
District of MacKenzie	3	3	3	3	1	0	0	1
District of Keewatin	3	1	1	3	2	0	0	2
District of Franklin	0	0	0	0	1	0	0	1

'The power levels 500 day/100 night may be increased to 1000 day/200 night when authorized by a Radio Inspector of the Department of Communications.

Frequency Band

A	1.800-1.825 MHz	E	1.900-1.925 MHz
B	1.825-1.850 MHz	F	1.925-1.950 MHz
C	1.850-1.875 MHz	G	1.950 1.975 MHz
D	1.875-1.900 MHz	H	1.975-2.000 MHz

Power Level — Watts

0 — Operation not permitted
1 — 25 night 125 day
2 — 50 night 250 day
3 — 100 night 500 day

*At presstime there was no official word on the implementation of the new WARC emissions designators, but we understand that the Department of Communications has the matter under consideration.

BAND PLANS

The ARRL supports regional frequency coordination efforts by amateur groups. Band plans published in the ARRL *Repeater Direc tory* are recommendations based on a consensus as to good amateur operating practice on a nationwide basis. In some cases, however, local conditions may dictate a variations from the nation band plan. In these cases, the written determination of the regiona frequency coordinating body shall prevail and be considered good amateur operating pratice in that region.

When considering frequencies for use in conjunction with a repeater be *sure* that both the input and output fall within subbanc authorized for repeater use, and do not extend past the subband edges. FCC regulation 97.61(c) defines frequencies which are currently available for repeater use. For example, a 2-meter repeater o exactly 145.50 MHz would be "out-of-band," as the deviation will p the signal outside of the authorized band segment.

23.300-29.700 MHz

29.300-29.500	Amateur Radio Satellites
29.520-29.580	Repeater inputs
29.600	Simplex
29.620-29.680	Repeater outputs

Repeater frequency pairs (input/output):

29.520/29.620	29.560/29.660
29.540/29.640	29.580/29.680

50-54 MHz

The following band plan was adopted by the ARRL Board of Direct April 1983 meeting.

50.000-50.100	CW and Beacons:
50.060-50.080	Automatically controlled Beacons
50.100-50.600	SSB and AM:
50.110	SSB DX calling frequency
50.200	SSB National calling frequency (Note: Sugges QSY up for local and down for long distance QSOs)
50.400	AM calling frequency
50.600-51.000	Experimental and Special Modes:
50.700	RTTY Calling Frequency
50.800-50.980	Radio Control (R/C), ten channels on 20 kHz raster.
51.000-51.100	Pacific DX Window
51.100-52.000	FM Simplex
52.000-52.050	Pacific DX Window
52.000-54.000	FM Repeater and Simplex

Repeater frequency pairs (input/output)

52.010/53.010	52.330/53.330	52.710/53.710
52.030/53.030	52.350/53.350	52.730/53.730
52.050/53.050	52.370/53.370	52.750/53.750
52.070/53.070	52.390/53.390	52.770/53.770
52.090/53.090	52.410/53.410	52.790/53.790
52.110/53.110	52.430/53.430	52.810/53.810
52.130/53.130	52.450/53.450	52.830/53.830
52.150/53.150	52.470/53.470	52.850/53.850
52.170/53.170	52.550/53.550	52.870/53.870
52.190/53.190	52.570/53.570	52.890/53.890
52.210/53.210	52.590/53.590	52.910/53.910
52.230/53.230	52.610/53.610	52.930/53.930
52.250/53.250	52.630/53.630	52.950/53.950
52.270/53.270	52.650/53.650	52.970/53.970
52.290/53.290	52.670/53.670	52.990/53.990
52.310/53.310	52.690/53.690	

Simplex frequencies: 52.490 52.510 52.525*

*National Simplex Frequency

144-148 MHz

The following band plan has been proposed by the ARRL VHF-UHF Advisory Committee.

144.00-144.05	EME (CW)
144.05-144.06	Propagation beacons
144.06-144.10	General CW and weak signals
144.10-144.20	EME and weak signal SSB
144.20	National calling frequency
144.20-144.30	General SSB operation
144.30-144.50	New OSCAR sub-band
144.50-144.60	Linear translator inputs
144.50-144.90	FM repeater inputs
144.90-145.10	Weak signal and FM simplex *
145.10-145.20	Linear translator outputs
145.10-145.50	FM repeater outputs
145.50-145.80	Miscellaneous and experimental modes
145.80-146.00	OSCAR sub-band
146.01-146.37	Repeater inputs
146.40-146.58	Simplex
146.61-147.39	Repeater outputs
147.42-147.57	Simplex
147.60-147.99	Repeater inputs

*The channels 145.01, .03, .05, .07 and .09 MHz are widely used for packet radio, and have been established by a number of frequency coordinators. Some have recognized Network Coordinating Agents to coordinate packet-radio use of these frequencies.

Repeater frequency pairs (input/output):

144.51/145.11	144.89/145.49	147.75/147.15
144.53/145.13	146.01/146.61	147.78/147.18
144.55/145.15	146.04/146.64	147.81/147.21
144.57/145.17	146.07/146.67	147.84/147.24
144.59/145.19	146.10/146.70	147.87/147.27
144.61/145.21	146.13/146.73	147.90/147.30
144.63/145.23	146.16/146.76	147.93/147.33
144.65/145.25	146.19/146.79	147.96/147.36
144.67/145.27	146.22/146.82	147.99/147.39
144.69/145.29	146.25/146.85	
144.71/145.31	146.28/146.88	
144.73/145.33	146.31/146.91	
144.75/145.35	146.34/146.94	
144.77/145.37	146.37/146.97	
144.79/145.39	146.40 or 147.60/147.00*	
144.81/145.41	146.43 or 147.63/147.03*	
144.83/145.43	146.46 or 147.66/147.06*	
144.85/145.45	147.69/147.09	
144.87/145.47	147.72/147.12	*local option

Some areas use 146.40-146.60 and 147.40-147.60 MHz for either simplex or repeater inputs and outputs. Frequency pairs in those areas are:

147.415/146.415	147.46/146.46	147.505/146.505
147.43/146.43	147.475/146.475	147.595/146.595
147.445/146.445	147.49/146.49	

For repeaters located east of the Continental Divide, the ARRL suggests standardizing on upright 15-kHz splinter channels; that is, all repeater frequency pairs are low in/high out between 146 and 147 MHz, and high in/low out between 147 and 148 MHz. Recognizing the existence of a significant minority of inverted split repeaters east of the Divide, and wishing to minimize expense and inconvenience of these repeater groups, the ARRL recommends a phase-in period of five years from this date for converting to the suggested system.

146.025/146.625	146.295/146.895	147.735/147.135
146.055/146.655	146.325/146.925	147.765/147.165
146.085/146.685	146.355/146.955	147.825/147.225
146.115/146.715	146.385/146.985	147.855/147.255
146.145/146.745	147.615/147.015	147.885/147.285
146.175/146.775	147.645/147.045	147.915/147.315
146.205/146.805	147.675/147.075	147.945/147.345
146.235/146.835	147.705/147.105	147.975/147.375
146.265/146.865		

*146.40	*146.505	147.42	147.525
*146.415	#146.52	147.435	147.54
*146.43	146.535	147.45	147.555
*146.445	146.55	147.465	147.57
*146.46	146.565	147.48	147.585
*146.475	146.58	147.495	
*146.49	146.595	147.51	

#National Simplex Frequency

*May also be a repeater (input or output). See repeater pairs listing.

Several states have chosen to re-align the 146-148 MHz band, using 20 kHz spacing between channels. This choice was made to gain additional repeater pairs.

The transition from 30 to 20 kHz spacing is taking place on a case by case basis as the need for additional pairs occurs. Typically the repeater on an *odd* numbered pair will shift 10 kHz, up or down, creating a new set on an even numbered channel. For example, the pair of 146.13/.73 would change to 146.12/.72 or 146.14/.74, while the pairs of 146.10/.70 and 146.16/.76 would be left status quo.

220-225 MHz

The following bandplan is currently under review by the ARRL VHF-UHF Advisory Committee.

220.00-220.05	EME (Earth-Moon-Earth)
220.05-220.06	Propagation beacons
220.06-220.10	Weak signal CW
220.10	Calling frequency
220.10-220.50	General weak signal, rag chewing and experimental communications
220.50-221.90	Experimental and control links
221.90-222.00	Weak signal guard band
222.00-222.05	EME
222.05-222.06	Propagation beacons
222.06-222.10	Weak signal CW
222.10	Calling frequency

Comments concerning packet-radio frequencies in this band may be sent to the VUAC and VRAC member in your Division.

Simplex frequencies:

223.42	223.52	223.62	223.72	223.82
223.44	223.54	223.64	223.74	223.84
223.46	223.56	223.66	223.76	223.86
223.48	223.58	223.68	223.78	223.88
223.50*	223.60	223.70	223.80	223.90

* National simplex frequency

Repeater frequency pairs (input/output):

222.32/223.92	222.54/224.14	222.76/224.36	222.98/224.58	223.20/224.80
222.34/223.94	222.56/224.16	222.78/224.38	223.00/224.60	223.22/224.82
222.36/223.96	222.58/224.18	222.80/224.40	223.02/224.62	223.24/224.84
222.38/223.98	222.60/224.20	222.82/224.42	223.04/224.64	223.26/224.86
222.40/224.00	222.62/224.22	222.84/224.44	223.06/224.66	223.28/224.88
222.42/224.02	222.64/224.24	222.86/224.46	223.08/224.68	223.30/224.90
222.44/224.04	222.66/224.26	222.88/224.48	223.10/224.70	223.32/224.92
222.46/224.06	222.68/224.28	222.90/224.50	223.12/224.72	223.34/224.94
222.48/224.08	222.70/224.30	222.92/224.52	223.14/224.74	223.36/224.96
222.50/224.10	222.72/224.32	222.94/224.54	223.16/224.76	223.38/224.98
222.52/224.12	222.74/224.34	222.96/224.56	223.18/224.78	

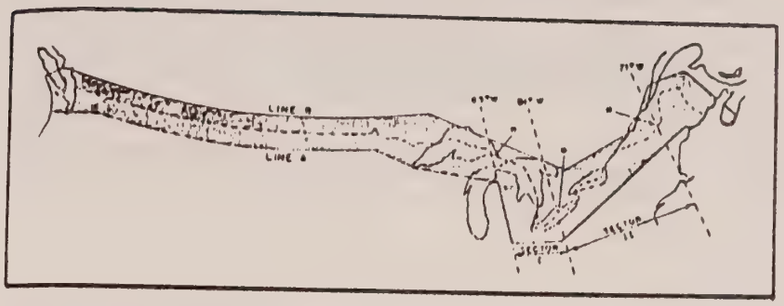
420-450 MHz

The following band plan is currently under review by the ARRL VHF Advisory Committee.

420.00-426.00	ATV repeater or simplex with 421.25 MHz video carrier, control links and experimental
426.00-432.00	ATV simplex with 427.250 MHz video carrier frequency
432.00-432.070	EME (Earth-Moon-Earth)
432.07-432.08	Propagation beacons
432.08-432.10	Weak signal CW
432.100	70-cm calling frequency
432.10-432.125	Mixed mode and weak signal work
432.125-432.175	OSCAR inputs
432.175-433.00	Mixed mode and weak signals
433.00-435.00	Auxiliary/repeater links
435.00-438.00	Satellite only (Internationally)
438.00-444.00	ATV repeater input with 439.250 MHz video carrier frequency and repeater links
442.00-445.00	Repeater inputs and outputs (local option)
445.00-447.00	Shared by auxiliary and control links, repeaters and simplex (local option)
446.0	National Simplex Frequency
447.00-450.00	Repeater inputs and outputs (local option)

Comments concerning packet-radio frequencies in this band may be sent to the VUAC and VRAC member in your Division.

The band is shared by amateurs with Government Radio location services (RADAR); amateurs must not interfere with these priority Government stations. As part of WARC-79 proceedings, the 420-430 MHz portion of the band was removed from the Amateur Radio Service north of Line A (see figure).



In a later action, FCC allocated portions of the band 421-430 MHz to the Land Mobile Service within 50-mile radii centered on Buffalo, Detroit and Cleveland. Amateur stations south of Line A in the vicinities of these cities may continue to operate in the 421-430 MHz spectrum as long as they do not cause interference to land mobile or government radiolocation users. Additionally, 50-watt PEP output power limitations apply to certain amateurs operating within circles of designated military installations in the U.S.

Repeater frequency pairs (input/output is local option):

442.000/447.000	442.775/447.775	443.550/448.550	444.325/449.325
442.025/447.025	442.800/447.800	443.575/448.575	444.350/449.350
442.050/447.050	442.825/447.825	443.600/448.600	444.375/449.375
442.075/447.075	442.850/447.850	443.625/448.625	444.400/449.400
442.100/447.100	442.875/447.875	443.650/448.650	444.425/449.425
442.125/447.125	442.900/447.900	443.675/448.675	444.450/449.450
442.150/447.150	442.925/447.925	443.700/448.700	444.475/449.475
442.175/447.175	442.950/447.950	443.725/448.725	444.500/449.500
442.200/447.200	442.975/447.975	443.750/448.750	444.525/449.525
442.225/447.225	443.000/448.000	443.775/448.775	444.550/449.550
442.250/447.250	443.025/448.025	443.800/448.800	444.575/449.575
442.275/447.275	443.050/448.050	443.825/448.825	444.600/449.600
442.300/447.300	443.075/448.075	443.850/448.850	444.625/449.625
442.325/447.325	443.100/448.100	443.875/448.875	444.650/449.650
442.350/447.350	443.125/448.125	443.900/448.900	444.675/449.675
442.375/447.375	443.150/448.150	443.925/448.925	444.700/449.700
442.400/447.400	443.175/448.175	443.950/448.950	444.725/449.725
442.425/447.425	443.200/448.200	443.975/448.975	444.750/449.750
442.450/447.450	443.225/448.225	444.000/449.000	444.775/449.775
442.475/447.475	443.250/448.250	444.025/449.025	444.800/449.800
442.500/447.500	443.275/448.275	444.050/449.050	444.825/449.825
442.525/447.525	443.300/448.300	444.075/449.075	444.850/449.850
442.550/447.550	443.325/448.325	444.100/449.100	444.875/449.875
442.575/447.575	443.350/448.350	444.125/449.125	444.900/449.900
442.600/447.600	443.375/448.375	444.150/449.150	444.925/449.925
442.625/447.625	443.400/448.400	444.175/449.175	444.950/449.950
442.650/447.650	443.425/448.425	444.200/449.200	444.975/449.975
442.675/447.675	443.450/448.450	444.225/449.225	
442.700/447.700	443.475/448.475	444.250/449.250	
442.725/447.725	443.500/448.500	444.275/449.275	
442.750/447.750	443.525/448.525	444.300/449.300	

902-928 MHz(1)

The following interim bandplan was adopted at the ARRL Board of Directors meeting in October 1984.

Segment	*Use*	*Footnotes*
902-904 MHz	Narrow bandwidth, weak signal communications	
902.0-902.8	SSTV, Fax, ACSSB, experimental	
902.8-903.0	Reserved for EME, CW expansion	
903.0-903.05	EME exclusive	
903.07-903.08	CW beacons	
903.1	CW, SSB calling frequency	
903.4-903.6	Crossband Linear Translator inputs	
903.6-903.8	Crossband Linear Translator outputs	
903.8-904.0	Experimental beacons exclusive	
904-906	Digital Communications	(2,8)
906-907	Narrow bandwidth FM simplex services, 25 kHz channels	
906.50	National simplex frequency	(6)
907-910	FM repeater inputs, paired with 919-922 MHz; 119 pairs every 25 kHz, e.g. 907.025, 050, 075, etc. 908-920 MHz uncoordinated pair.	
910-916	ATV	(2,4)
916-918	Digital Communications	(2,3)
918-919	Narrow bandwidth, FM control links and remote bases	(2,8)
919-922	FM repeater outputs, paired with 907-910 MHz	
922-928	Wide bandwidth experimental, simplex ATV, Spread Spectrum	(2,4) (5,7)

Canadian amateurs note: The amateur service will continue to have secondary status in the band 902-928 MHz throughout Canada, using any of the following emissions: N0N, A1A, A2A, A3C, A3E, C3F, F1A, F2A, F2B, F1C, F3E. Before operation in this band, Canadian amateurs licensees are required to consult with their DOC District Office to ensure interference will not be caused to other services operating in the area as per Section 45 of the General Radio Regulations Part II, given in TRC 25.
Government of Canada shipborne radiolocation service is permitted within 150 km of the East and West Coasts, Arctic Ocean, Hudson Bay, James Bay and up the St. Lawrence River as far as Rimouski on pre-coordinated channels in the 902-928 MHz band.

Footnotes

1) Extracts of FCC Rules & Regulations, paragraph 2.106 "Table of Frequency Allocations" modified by General Docket 80-739, 8 Dec. 1983: Footnote US-267: "In the band 902-928 MHz, Amateur Radio stations shall not operate within the states of Colorado and Wyoming, bounded by the area of: latitude 39°N-42°N and longitude 103°W-108°W." Footnote US-275: "The band 902-928 MHz is allocated on a secondary basis to the amateur service subject to not causing harmful interference to the operations of Government stations authorized in this band or to Automatic Vehicle Monitoring (AVM) systems. Stations in the amateur service must tolerate any interference from the operations of industrial, scientific and medical (ISM) devices, AVM systems and the operations of Government stations authorized in this band."
2) Coordinated frequency assignments required.
3) ATV assignments should be made according to modulation type, e.g. VSB-ATV, SSB-ATV or combinations. Coordination of multiple uses of a single channel in a local area can be achieved through isolation by means of cross-polarization and directional antennas.
4) Coordinated assignments at 100 kHz until allocations are filled, then assign 50 kHz until allocations are filled, before assigning 25-kHz channels.
5) Simplex services only, permanent users shall not be coordinated in this segment. High altitude repeaters for other unattended fixed operations are not permitted.
6) Voice and non-voice operation.
7) Spread-spectrum requires FCC authorization.
8) Consult FCC R&R 97.69 for allowable data rates and bandwidths.

1240-1300 MHz

The following band plan was adopted by the ARRL Board of Directors meeting in January 1985.

Segment	*Use*	*Footnotes*
1240-1246	ATV #1	(2,3)
1246-1248	Narrow-bandwidth FM point-to-point links and digital, duplex with 1258-1260	(2)
1248-1252	Digital Communications	(2,8,9)
1252-1258	ATV #2	(2,3)
1258-1260	Narrow-bandwidth FM point-to-point links and digital, duplexed with 1246-1252	(2)
1260-1270	Satellite uplinks, reference WARC 1979	
1260-1270	Wide-bandwidth experimental, simplex ATV	(5,6)
1270-1276	Repeater inputs, FM and linear, paired with 1282-1288, 239 pairs every 25 kHz, e.g. 1270.025, .050, .075, etc. 1271.0-1283.0 uncoordinated test pair	
1276-1282	ATV #3	(2,4,9,10)
1282-1288	Repeater outputs, paired with 1270-1276	(2,3)
1288-1294	Wide-bandwidth experimental, simplex ATV	(2,4,9,10)
1294-1295	Narrow-bandwidth FM simplex services, 25-kHz channels	(6) (7)
1294.5	National FM simplex calling frequency	
1295-1297	Narrow bandwidth weak-signal communications (no FM)	
1295.0-1295.8	SSTV, FAX, ACSB, experimental	
1295.8-1296.0	Reserved for EME, CW expansion	
1296.0-1296.05	EME-exclusive	
1296.07-1296.08	CW beacons	
1296.1	CW, SSB calling frequency	
1296.4-1296.6	Crossband linear translator input	
1296.6-1296.8	Crossband linear translator output	
1296.8-1297.0	Experimental beacons (exclusive)	
1297-1300	Digital Communications	

Footnotes

1) Deleted
2) Coordinated assignments required.
3) ATV assignments should be made according to modulation type (for example), VSB-ATV, SSB-ATV, or combinations). Coordination of multiple users of a single channel in a local area can be achieved through isolation by means of cross polarization and directional antennas. DSB ATV may be used, but only when local and regional activity levels permit. The excess bandwidths from such users are secondary to the assigned services.
4) Coordinate assignments with 100-kHz channels, beginning at the lower end of the segment until allocations are filled, then assign 50-kHz channels until allocations are filled before assigning 25-kHz channels.
5) Wide bandwidth experimental users are secondary to the satellite service and may be displaced upon the installation of any new satellites. Users are EIRP-limited to the noise floor of the satellites in service and may suffer interference from satellite uplinks.
6) Simplex services only; permanent users shall not be coordinated in this segment. High-altitude repeaters or other unattended fixed operations are not permitted.
7) Voice and non-voice operations.
8) Consult 47 C.F.R. 97.69 (FCC regulations) for allowable data rates and bandwidths.
9) Provide guard bands at the higher frequency end of segments, as required, to avoid interference to ATV.
10) 1274.0-1274.2 and 1286.0-1286.2 MHz are optionally reserved for contiguous Linear Translators supporting multiple narrow bandwidth users. These may also be duplexed with other non-coordinated band segments.

RF, RF, WHERE IS MY HIGH SPEED RF?

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Abstract

This paper presents some thoughts of where we are now and where we are heading in the RF hardware evolution of Amateur packet radio. It may be a disappointment to some in that it raises more questions than it answers. I feel it is vital ot raise these questions now, since this is where we need the most work.

Amateur Radio is a hobby for "Radio" operators. It seems that a lot of us (myself included) have either forgotten that, or aren't willing to spend the time in RF design any more. Even when we try to work on RF problems (such as channel congestion) we tend to try clever "digital tricks" rather than look at the basic problem. Boy have we become spoiled! While we have advanced greatly in a short time in the digital end of packet radio, our RF technology lags further and further behind (just by staying at the same place). There have been only one or two contributions made in the last year or so.

This is particularly bad when one looks at the overall picture of the Amateur Packet Radio Network. For the last six months all I have heard is the same question: "Where is the Network Layer?" I hate to be the bearer of bad news, but that isn't where our efforts should be concentrated. The Network Layer camps are progressing fine, which just adds to the problem. How can this be? The answer is in the term "overhead". It doesn't matter if Virtual Circuits or Datagrams are used, both will add a lot of data that must be passed over the same already crowded RF paths. This means either more packets or longer packets will be flying through our RF. If you think our channels are congested now, just wait until the packet switches come on-line!

My answer to the question of where do we need the most work in packet radio right now is therefore simple, ALL PHASES OF THE RF WE USE! Having said that, I must now back down and admit that I cannot/will not alter my own course and proceed into the RF domain, I am too involved in the Network Layer development. The above comments are meant as a challenge to all those who do have the expertise to work in RF. WE DO NEED YOUR HELP! We need newer and faster radio and modem designs, NOW.

HF Packet Operation

In the last year there has been a large growth in the amount of HF packet operation. Almost all of this operation has been centered around the frequency of 14.103 mHz. The present technology being used is 200 Hz shift AFSK 300 bps lower sideband. Since this one frequency is being used both in the U.S. and Europe, it has become quite crowded most of the time. To add to the problem, some complaints have been surfacing about interference from the packet operation to nearby DX beacons operating on 14.100 mHz, which are used to detect band openings.

Bob Bruninga, WB4APR has been operating an HF station/gateway on 10.147 (USB) for over a year now. As more equipment is becoming available to operate 30 meters, it might be time to move some of the auto-forwarding stations from 20 meters to 30 meters. This might help reduce the congestion on 14.103, show more activity on 30 meters, and help the DX amateurs all at the same time. I would hope to see more operation on 10.147 mHz over the next year.

As far as technological improvements on HF goes, I haven't heard of much lately. Paul Rinaldo still has a couple of Packet Adaptive Modem (PAM) prototypes built, but no one has done any serious experiments with them. These modem devices were described in the Second ARRL Computer Networking Conference Proceedings and are a first step toward minimum-shift-keying (MSK) operation on HF. We need someone to pick up the ball and test these devices, or alternatively come up with some other scheme of increasing the data speed on HF packet.

VHF/UHF Packet Operation

Amateur packet radio is really taking off on VHF and UHF. Some of the common bands and frequencies of use are as follows:

Two Meters (These are fairly standard nation-wide):

145.010 mHz (mostly National Backbone).
145.030 mHz (some local net operations).
145.050 mHz (mostly local net operation)
145.070 mHz (some local net operation).
145.090 mHz (some local net operation).

220 mHz, Low speed channels (1200 bps):
(these have been requested from T-Marc in the D.C. area, the last five may have other services on them by now).

221.010 mHz (some east-coast backbone).
221.030 mHz
221.050 mHz
221.070 mHz
221.090 mHz
221.110 mHz
221.130 mHz
221.150 mHz
221.170 mHz
221.190 mHz

220 mHz wide-band channels (100 kHz channels centered around the following freq):
(again specifically requested of T-Marc in D.C.)

220.550 mHz
220.650 mHz
220.750 mHz
220.850 mHz
220.950 mHz

440 mHz narrow-band channel (1200 bps):
(again, requested of T-Marc in the D.C. area)

441.000 mHz

440 mHz wide-band channels (100 kHz bandwidth centered around the following freq.):
(requested of T-Marc in the D.C. area)

430.050 mHz
430.150 mHz
430.250 mHz
430.350 mHz
430.450 mHz
430.550 mHz
430.650 mHz
430.850 mHz
430.950 mHz

I should point out that the above frequencies have NOT been set aside specifically for packet radio at this point, but rather may be available for use IF WE NEED THEM.

They were requested to be set aside for packet use by one of the local Washington D.C. clubs (Tri-State Amateur Radio Club). We need to get some radios up on these frequencies before yet another voice repeater uses them up, or they are given to some other spectrum-starved service.

At this time there has not been much work in trying to get frequencies assigned to packet radio in either the 900 mHz band or the 1215 mHz band (in the Washington D.C. area at least).

Michigan Packet Radio Frequency Plan

Another packet radio frequency plan surfaced recently from Michigan. Apparently there was a state-wide meeting in mid-November of 1985, the results of which are as follows:

144-148 mHz

Apparently the Michigan Repeater Council does not coordinate packet channels on two meters, so the following is by "gentleman's agreement" rather than an official coordination:

144.910 mHz (Experimantal and QRP)
144.930 mHz (Local Area Network)
144.950 mHz (Local Area Network)
144.970 mHz (Local Area Network)
144.990 mHz (Non-Digipeated simplex)
145.010 mHz (Inter-Lan & Forwarding)
145.030 mHz (Local Area Network)
145.050 mHz (Local Area Network)
145.070 mHz (Local Area Network)
145.090 mHz (Experimental and QRP)

The Michigan group took a different approach for 220 mHz. They reserved several frequencies for full-duplex low-speed repeaters and simplex digipeaters, and four freqs for 9600 bps test channels, but pushed the higher speed packet operation up to 430 mHz, with only 50 kHz channels even there. The rest of their bandplan is as follows:

220 mHz low-speed (1200bps) full-duplex repeater channels:

OUT	IN	OUT	IN
220.52 mHz/	222.12 mHz	220.64 mHz/	222.24 mHz
220.54 mHz/	222.14 mHz	220.66 mHz/	222.26 mHz
220.56 mHz/	222.16 mHz	220.68 mHz/	222.28 mHz
220.58 mHz/	222.18 mHz	220.70 mHz/	222.30 mHz
220.60 mHz/	222.20 mHz	220.72 mHz/	222.32 mHz
220.62 mHz/	222.22 mHz		

220 mHz simplex low-speed channels:

220.74 mHz, 220.76 mHz, and 220.78 mHz

220 mHz 9600 bps channels (uncoordinated):

220.825 mHz, 220.875 mHz, 220.925 mHz, 220.975 mHz

There would be nineteen coordinated 50 kHz channels for linking in the 430-431 mHz band segment as follows:

430.025 mHz	430.275 mHz	430.525 mHz	430.775 mHz
430.075 mHz	430.325 mHz	430.575 mHz	430.825 mHz
430.125 mHz	430.375 mHz	430.625 mHz	430.875 mHz
430.175 mHz	430.425 mHz	430.675 mHz	430.925 mHz
430.225 mHz	430.475 mHz	430.725 mHz	

The above information is being given here primarily to show that there are frequencies out there (for most of the country at least), and that the packet community IS being recognized and served by the frequency coordinating bodies. It is also being given to (hopefully) aid in the development of RF equipment for these bands.

Simplex vs Full-Duplex Digipeater Operation

Way back when, when packet radio was still mainly in Vancouver, I was pushing the use of full-duplex repeaters. At the time I was convinced of the error of my ways (at K8MMO's house one night, I remember). A simplex digipeater is MUCH easier and cheaper to put up. With just a TNC and a radio you too can put up a simplex digipeater. The only disadvantage of a simplex digipeater is the lower throughput. Is the loss of throughput made up by the cheaper cost of simplex digipeaters? Well, I'm not sure, but I feel it is time once again to look at repeater operation.

Some of the advantages of simplex digipeaters are:

A. The cost of a simplex digipeater is MUCH smaller than that of a full-duplex one.

B. The complexity of a simplex digipeater is also much less, especially in the RF plumbing required (ie. filters).

C. A simplex digipeater is also physically smaller, allowing it to be placed in remote areas more easily.

D. Since there is less equipment, it is less likely to require maintenance, and less control circuitry may be needed.

E. In order to use full-duplex to full advantage, user radios should also be capable of full duplex operation, driving the user cost up drastically.

The only real disadvantage to simplex digipeaters is that it has less throughput than a full-duplex type repeater. Some of the reasons for this reduced throughput follow.

One reason often mentioned for reduced throughput of a simplex digipeater is that it time-shares the same frequency for both receive and transmit, thus reducing the throughput by at least 50%. Actually, this is not completely true when one considers that full-duplex operation uses two frequencies. If two separate simplex digipeaters were put on the frequencies used by a full-duplex digipeaters, almost all of the channel capability can be recovered. The only amount of channel capability still lost would be the receive/transmit turn-around time, both at the individual stations and at the digipeater.

The other major loss of channel throughput in a simplex digipeater system is due to the hidden station syndrome. Since stations using the same digipeater may not be able to hear each other, one station may start transmitting a packet to the digipeater while another station was already sending a packet to the digipeater, or some other station on the same frequency, causing a collision and possible loss of data. In full-duplex digipeater operation this would be much less likely to happen, since all other stations would hear any station that starts to transmit on the repeater input (except for the small transition time between receive and transmit at the individual stations) on the repeater output.

Cross-Band Operation

Some hams have suggested that in order to reduce the amount of plumbing needed at digipeaters that the digipeaters receive on one band and transmit on another band. This cross-band operation would allow full-duplex operation at reduced cost and size.

Channel Access Methods

How stations gain access to the RF channel to pass data is another descision that must be made. Some of the different systems to chose from are listed below.

Aloha Type Channel Access Method

The first major packet radio network was the Aloha Network built in Hawaii. The Aloha Network used the RF channel by having a station immediately transmit data whenever it had some to send. Collisions of transmissions were detected by not receiving an acknowledgement of the data by a certain time. The theoretical maximum channel utilitization using pure Aloha is 18%.

Slotted Aloha Channel Access Method

One of the problems with pure Aloha is that anyone can transmit packets at any time. One method to increase channel utilitization is to divide the potential transmit time into discrete time-slices or slots, each of which is slightly longer than the time it takes to send a packet.

Once the stations are synchronized (usually by having a master station transmit a short clock pulse), a station will only transmit at the beginning of a slot. This reduces the amount of collisions, since stations will no longer accidentally transmit part-way through another stations packet transmission. Packets either make it through fully, or are fully destroyed. Using Slotted Aloha just about doubles the channel throughput to about 37%.

Reservation Aloha Channel Access Method

Another method used to improve channel utilitization over pure Aloha is to reserve specific time slots for each station to transmit data. There are several different schemes as to how these reservations are made and maintained, but basically they all assign times for stations to transmit, thereby greatly reducing collisions.

Token-Type Channel Access Method

Yet another method of controlling access to the data channel is to allow transmissions by a station only when it has "permission". This permission is usually in the form of a "token". This token is passed back and forth by all the stations on the channel. When a station receives the token, it checks to see if it has data to send. If it does, it sends the data, then passes on the token to the next station. If it has no data, it immediately passes on the token to the next station.

Among the disadvantages to token type access methods is that they must be carefully supervised. In order for additional stations to be accepted onto the channel, they must somehow be added to the token-passing list. The easiest way to have this function properly is to have a master station monitor the token passing and allow new station(s) in whenever it has the token.

Carrier-Sense Multiple Access (CSMA)

The method we Amateurs presently use to gain access to the RF channel is through a system called Carrier-Sense Multiple Access, or CSMA. CSMA is a fancy term for how we hams have shared our spectrum space all these years. Basically it means you are supposed to listen for others before you transmit. If you hear someone else on the channel, you wait until they are done before you start transmitting. With many people competing for the same channel, CSMA is a good method to control channel access.

The biggest problem associated with simple CSMA is what is called the "hidden transmitter" situation. There is a possibility that whenever a half-duplex channel is used, not all stations can hear all other stations. In fact, with the Amateur Packet Network of today with simplex digipeaters, this is quite likely. Whenever a station is hidden from another station, the possibility of both of them transmitting at the same time exists, since they cannot sense each other. The possibility of collisions expands greatly with the addition of each station that cannot hear another station. The degradation of the channel quickly reaches the point where there are more collisions than normal transmissions. Several schemes have been devised to overcome this situation.

One system for recovering from collisions in a CSMA enviroment involves "persistence". Persistence has to do with how a station handles access to a busy channel when it has data to send. Suppose a station has data to send, but detects the channel is busy. One method of handling this situation is for the station to transmit its data as soon as it thinks the channel is free. This is called 1-persistence because the probability of the station transmitting when detecting the idle channel is 1.

The other extreme in persistence is called nonpersistent CSMA. In this case, when the station detects the busy channel, it doesn't wait for the channel to become free and immediately transmit. Rather, it waits a random amount of time and then tests the channel again. If the channel is free, it will transmit. If the channel is still busy, the station repeats the wait and test cycle until the channel becomes free.

A third persistence scheme is called p-persistent CSMA. This is a compromise between the above two systems. When a station has data to send, it will first check for an idle channel condition. If the channel is free, it will transmit its data with a probability of p. If the channel is busy, the station will wait until the channel is idle before invoking the probability test for transmission. If the value of p is different for each station, this can reduce the potential for collisions of transmissions.

CSMA with Collision Detect

A modification to the basic CSMA operation involves monitoring the channel while transmitting. This means a full-duplex channel is being used. If, while transmitting data, a station detects that its data is not what's on the channel, another station has taken over the channel and the monitoring station should stop transmitting. Since all stations can now hear all other stations, the hidden station problem is almost completely eliminated. This collision detection can help reduce the number of collisions, at the cost of all stations being required to operate in full-duplex mode. If full-duplex capability is possible, CSMA-CD can be the most effective use of a channel.

Busy-Tone CSMA System

Another method of reducing collisions on a CSMA channel is to use a busy-tone to indicate when the channel is being used. This requires that the channel is being controlled by a master station with which the individual stations communicate. It also requires that a secondary channel be available to transmit a busy signal. This secondary channel does not have to be a full data type channel as the presence or absence of a busy signal is the only information carried on the secondary channel. Whenever the master station is receiving data from a station, it sends out the busy-signal on the secondary channel. Once the main data channel is free, the master drops the busy-signal. The individual stations monitor the channel for the busy-signal before transmitting data. This system also helps reduce the amount of collisions due to hidden stations, although not as effectively as the collision detect mechanism described above.

While this busy-signal system does improve channel access, it is not as effective as the CSMA-CD system mentioned above, for about the same complexity. This busy-signal system has been tried on the Amateur bands, and it is more effective than the simple CSMA we presently use.

With the above in mind, lets look at how these trade-offs are made in two different parts of the packet radio network.

Individual User/Local Network Operation

We are using simplex digipeaters almost exclusively at this point. I believe this is the best use of the RF channels we use at this point. Full-duplex repeater operation is not feasible on two meters with our present allocation, since the five main channels are right next to each other in frequency. In some areas, full-duplex (voice type) repeater assignments may be available, but are the users willing to pay the added costs to put up a full-duplex digipeaters? From what I have seen, the answer is no. It appears that a more palatable solution to channel congestion is to put up more digipeaters. Brian, WB6RQN tried to run an experiment by putting his Unix system on the AMRAD voice repeater (147.81/21 mHz). This test was met with a great yawn. Admittedly, the repeater lost some coverage part of the way into the experiment due to loss of antenna height at the repeater. I don't think this was the main reason for the lack of interest. I think that most everybody has accepted simplex digipeater operation for packet use for now.

Cross-band operation is not a viable option for the user/Local net due to its added expense for a second rig and antenna system at every location.

I mentioned that some hams have used a busy-signal system with digipeaters to reduce

collisions. If the users are willing to pay for another receiver (or be lucky enough to find a repeater pair to use), this system may be a viable alternative. It does greatly reduce the hidden station problem, without requiring full-duplex operation at all locations, as CSMA-CD would.

My conclusion however, is that at this time simplex repeater operation is still the best way to go for Local Network operation. In the future this may change, especially if the Local Network becomes more of a cellular type operation at 900 mHz. For now, if a channel get too congested, it is easy enough to put up another simplex digipeater (ala FM voice repeater growth).

Local Network vs Backbone Network

I wanted to mention briefly that there should be a re-thinking of how our packet channels are being used. Both the Michigan Bandplan and the Tri-State frequency requests indicate the use of some frequencies for "local networks", while other frequencies have been set aside for "network backbone" operation. This is a very important point. We should start using the "local network" frequencies for small areas, such as small towns, or one part of a metropolitan area. These local network frequencies would be re-used by other small groups far enough away to avoid complete RF overlap (if we use simplex digipeaters, the occasional overlap won't affect operation much). The local networks would then have access to the backbone via dual-port digipeaters or multi-port packet switches. A local area digipeater or packet switch should only cover as much as it needs to for the local group. This frequency re-use works almost like the cellular system, where each local network is a "cell" and the cells are hooked together by the backbone.

The main idea I want to get across is that putting up a super-digipeater for a "local" network can be counter-productive. The super-digipeaters work best for the backbone, where they need to reach as far as possible (remember, we can only chain eight of them together). Keep the "local network" digipeater coverage within the "local" area.

Network Backbone RF Operation

There have been many different suggestions for how we should construct the RF part of the network backbone. Presently, we are using simplex digipeaters here also. Once again, I think this is mainly because they are cheap to put up. Another reason is that up until recently, if a digipeater was to use something other than the main frequency, it would it have to use two TNCs and two radios.

One of the common suggestions made for use of our frequencies for the network backbone is to imply direction by frequency. For example, if a packet is to be routed south from a switch, the packet would be sent on one frequency. Packets going north would be sent on a different frequency. East and West bound packets would be sent on still different frequncies.

This idea requires a lot of smarts in the switch, so it can control which radio channel to send the data, and therefore which radio. We should be able to do this someday, but it may be beyond our reach in the near future. In addition, this adds a lot to the cost, size, and antenna requirements of the digipeater or switch.

What's Happening Now?

Present packet operation is still mostly on two meters at 1200 bps using Bell 202 type modems. As an example, almost all of the east-coast backbone operation is still on 145.010 mHz.

One improvement is that some local areas have begun using the other two meter packet channels as local networks as suggested above. These local networks are usually concentrating around a local packet bulletin board (PBBS). In the Washington D.C. area for example there are at least two different groups using 145.050 mHz for local network traffic. The use of "Super-Digipeaters" seems to be fading, except for the backbone. In order to reduce the channel congestion (especially while using half-duplex digipeaters) this trend to localized networking will be very beneficial.

At the Fourth ARRL Computer Network Conference (March 30, 1985 in San Francisco) Steve Goode, K9NG described a method of modifying the Hamtronics FM-5 220 mHz tranceiver for 9600 bps operation. Since then TAPR has made boards available for this modification, and some hams around the country have tried this mod on various rigs, with different degrees of success. Unfortunately, I have heard some negative comments about the use of these "off-the-shelf" rigs when modified for high-speed packet operation, especially in uncontrolled enviroments (such as one might expect at a digipeater like WB4JFI-5).

One suggested method of curing some of the problems encountered is to replace the standard IF filter(s) in the modified radios with slightly wider ones, allowing more "slop" in the IF bandwidth.

Moving to 220 mHz, The First Step

In order to reduce the amount of traffic on the network backbone, I propose that we make the first step to 220 mHz operation. This step is fairly simple, we just add a 220 mHz 1200 bps digipeater wherever there is a two meter digipeater in the backbone. This parallel path can be enchanced at various points by installing a dual-port digipeater (ala Jon Bloom, KE3Z and a Xerox 820 board) instead of the normal TNC type digipeater. This parallel path will allow us to check the RF paths and also provide more data throughput on the network. Heavy users of the backbone (PBBS's) could then use one path while the other path could be used for lighter traffic. Another advantage of going to 220 mHz even at 1200 bps is that it reduces the number of stations that have access to the backbone directly, thereby reducing channel occupancy, since not as many hams have 220 mHz capability.

AMRAD should be making this first step about the time of this conference. We are improving WB4JFI-5 to a dual-port digipeater with access on both 145.010 mHz and 221.010 mHz, both at 1200 bps for now.

9600 bps on 220 mHz

As mentioned earlier, some effort has been made to design higher speed radios at 220 mHz. Steve Goode, K9NG did a good job on his "modem" modification to the Hamtronics FM-5. Even so, some hams have found that they have to continually fight the rig to keep it operating properly. I feel that this is at least partially due to the fact that the FM-5 is still basically a voice type radio, optimized for voice operation (especially in the bandwidth department). What we really need is a radio that was designed from the ground-up as an "RF-Modem" rather than a voice rig.

Another person that has felt that way is Gary Fields of Boston, Mass. He has been working for a while now on a complete 220 mHz radio that is designed to be an RF modem. While he hasn't finished it yet (last I heard) it sounds promising.

Another effort being made on the 9600 bps 220 mHz front is being done by the AMRAD crowd. Chuck Phillips, N4EZV (of spread spectrum fame) and Andre Kestloot, N4ICK are working on a 220 mHz RF-Modem design. It is suprising how much like a modem it looks. They are presenting a paper on their design ideas elsewhere in these proceeding so I will not steal their thunder here.

I hope 1986 will be the year for 9600 bps 220 mHz packet radio, its overdue and needed desperately.

56kbps Design Request by ARRL Digital Committee

The ARRL Digital Committee met last December at Newington, CT and one of the items on the agenda was (suprise!) higher speed radios. The committee came up with a wish list for the design of a digital radio for high-speed data. The basic design involves the use of a data interface/IF modem followed by a transverter to the band of choice. The IF frequency in/out of the data/IF interface should be 28 mHz with RF levels to match

standard transverters (around 10 mw?). The data interface should accept standard serial data signals at either TTL or RS-422 levels. The data signals should be as follows:

Signal	Data/IF	TNC
RxData	--->	
TxData	<---	
RxClock (X1 speed)	--->	
TxClock (X1 speed)	--->	
Data Carrier Detect	--->	
Request-to-Send	<---	

The signalling speed of the complete data/IF/transverter chain should be at least 56 kbps, preferably using standard FSK FM modulation. The bands of operation should include 220 mHz, 440 mHz, and possibly 900 and 1215 mHz. It should operate in a 100 kHz channel, and should provide a clean RF output. Full duplex operation of the Data/IF interface should be possible, and the Rx/Tx switching speed should be extremely fast.

Anyone wishing a nice RF challenge should look no further. A radio that meets the above specs would be very welcome indeed!

Conclusion

Unfortunately, we have not progressed in the RF portion of packet radio development as quickly as we need to. There is still a lot of room to experiment with radio designs. The should be a welcome challenge to some enthusiastic Amateur out there who knows RF, and wants to learn about digital transmission methods and packet radio.

There is a world of variations available for the RF digital designer. Just tell us what you need, and we will supply the bits! If this sounds a bit like I am begging, I am. I WANT FASTER RADIOS!!

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WESTERN MICHIGAN PACKET RADIO ASSOCIATION

P.O. Box 4612, Muskegon Hts., MI 49444

TO: All Members Of the MARC PAC

FROM: Len Todd, N8AGS
18094 Fruitport Rd.
Spring Lake, MI 49456

SUBJECT: Packet Band Plan Proposals

Enclosed you will find:

1.) An excerpt for the Idea Newsletter covering the OHIO Area's thoughs on band planning.

2.) A copy of a message sent to me from WB9MJN, a leader of the Chicago Area packet activity. This message outlines some of his thoughts about our band plans.

3.) A copy of the current two meter proposal as drafted from the results of our last PAC meeting.

4.) A revised plan of MY Personal thoughts toward the current band plans on the 220 Mhz band. (this plan includes all of the PRISM concerns and still meets the known needs of other potential users.)

One interesting note. As you read this,the membership of WMPRA are planning to implement Packet activity on the 440 Mhz band. Our thoughts are to avoid activity on 220 Mhz and go directly to 440 Mhz. This change in our thinking was caused by the lack of adaquate 220 Mhz gear and the fears of the novice privilages being awarded in the 220 Band. This indicates that we must start planning for the packet activity to spread through the 440 band. Now is the time to formulate our plans. Ohio's plan,as indicated in the IDEA newsletter, appears to be going in the right direction.

Len Todd

Len Todd, N8AGS

WMPRA, President

10. NOTE FOR PROGRAMMERS Since the adapter uses the native code of the host computer no cross compilers are needed for anyone wanting to develop his own code.

ORDERING INFORMATION AND PRICE : All prices are in US$ and include postage and handling in USA or Canada. Please add 3$ for overseas orders.

1. Assembled and tested board with AX.25 host software and self-test progras (4 programs and documentation) $199.00

2. Bare board with AX.25 software and construction details $75.00

3. AX.25 software $40.00

4. Bulletin board & file transfer progras $25.00

5. Advanced VADCG experimental software $ 25.00

Make checks and money orders payable to H.A.P.N.

The mailing address is :

HAPN
Box 4466, Station D,
Hamilton, Ontario,
Canada, L8V4S7
(Via ORNET)

TNC 2 and KANTRONICS Hints

If you are planning on using your TAPR TNC 2on HF, take note of the following problem. A "birdie" may appear every seven kHz on the HF bands. This is caused by the 556 Oscillator/Timer U2. To correct this problem, place a bypass capacitor between pins 3 and 7 and pins 11 and 7 of U2. The value of the capacitor does not seem to be critical, and can be between 0.22 uF and 0.1 uF. This procedure should clear up the problem.

The following information applies only to TNC 2 Rev2. Symptom: The digital loopback test on pages 47 and 48 of the TAPR TNC 2 ASSEMBLY MANUAL fails. No CONNECTED message is displayed, or is intermittent. Solution: change R98 from a 4.7 k to a 100 k resistor. Change C10 from a 10 uf to a 47 uf capacitor. Remember, these mods are for TNC 2, Rev 2 units only. (via HamNet)

KANTRONICS vs. TAPR HF FREQ.

"It is sometimes confusing to Kantronics users to understand why they are not on the same HF frequency as TAPR users. The reason is that the TAPR design uses a low tone of 1600 Hz and a high tone of 1800 Hz.The Kantronics TNC is using a tone pair of 2025 Hz/2225 Hz. As you can see, this tone pair is exactly 425 Hz higher then the pair used in the TAPR TNC. Since the tones are 425 Hz higher, you must tune your transceiver 425 Hz higher to compensate."

THE OHIO PACKET COUNCIL
1 February 1986
A Proposed Spectrum Use Plan for Packet Operations
by Joe Kasser, W0RSI

Background

The demands on VHF and UHF spectrum in Amateur radio have been growing at a rate that no one could have ever foreseen. In addition, Packet, as a new mode has grown in a way that none of the original proponents of the mode would have ever predicted. In order, not only to provide for continued orderly growth, but to provide for future Packet activities that have yet to be conceived by those in the Amateur ranks who contribute so much to the development of new technologies, we must coordinate frequencies for our current and future use now.

I have studied several packet frequency proposals. I would like to present for consideration a proposal, adopting the best of the proposals which I have had the opportunity to review. A proposal which, I believe, will serve the Packet operators and the general Amateur population of Ohio for many years. This plan provides for orderly growth of Packet operation, while at the same time avoiding any conflict with currently coordinated users of the VHF and UHF spectrum.

The 144 MHz band is the most heavily utilized Amateur band. This heavy utilization extends to all modes, including Packet. Since this band currently bears the bulk of Packet activity we must immediately take steps to spread the load among several frequencies. The most important step in this process

is the LAN (Local Area Net) concept. I propose that OPaC adopt a plan of action which would move all local activity off 145.01 and on to a LAN frequency by April 1, 1986. In order to accomplish this and still maintain effective communication throughout the entire state each LAN should have, as its hub, either a (KE3Z) dual-port digipeater or a WORLI compatible MailBox/GateWay system. The "A" port of each system would be on the LAN frequency with the "B" port on 145.01 MHz (to provide for mail AutoForwarding (and possibly limited real-time connections via the GateWay function). It will be necessary to maintain a network of high-profile digipeaters on 145.01 to facilitate this mail forwarding. However, use of the .01 digipeaters for general "rag-chew" and DX type operation should be minimized.

Ten 1200 baud Simplex frequencies:

144.91	Non-network activity
144.93	Local Area Network
144.95	Local Area Network
144.97	Local Area Network
144.99	Non-digipeated Packet Simplex
145.01	Inter-LAN and National Mail Forwarding
145.03	Local Area Network
145.05	Local Area Network
145.07	Local Area Network
145.09	Non-compatible BBS

Note: LAN frequencies would be available for reuse in other areas for non-network activity on a non-interference basis. Each local area would be expected to have a primary outlet for incoming traffic (primarily store and forward) and an outlet to the .01 backbone for outgoing traffic.

It is not our intention to replace the existing backbone network on 145.01 MHz with these frequencies, to the contrary, the existing .01 network will need to be expanded in many areas to fill existing "holes". However, These additional frequencies would supplement the network, providing room for immediate growth and increased efficiency by segregating local and long-haul traffic.

The objective in any band-plan is to avoid conflict with existing voice operations (if any exist) on the above frequencies. It is important that packet expand in a contiguous group of frequencies and not all over the 2 meter band. This will help "carve out" a segment of 2 meters which ultimately will become recognized as a "packet subband".

220 MHz

It is important to provide room on the 220-225 Mhz band for both 1200 baud and 9600 baud packet. Meaningful Public Service communication cannot occur on 2 meters while stations in a Red Cross building or in an EOC are simultaneously engaged in voice nets through 2 meter systems (and that is where virtually all emergency voice nets are held) since the two transceivers on two meters will desense each other. Using 220 for packet allows general emergency nets on 144 Mhz and voice coordination of packet and logistical traffic on 440 MHz repeaters and frequencies. Also, with enough channels for 1200 baud work, both Public Service and more general packet communication can coexist on the same band without the traffic from one kind of activity causing problems for the other.

Fourteen 1200 baud Simplex/LAN frequencies

220.520 MHz	220.660 MHz
220.540 MHz	220.680 MHz
220.560 MHz	220.700 MHz
220.580 MHz	220.720 MHz
220.600 MHz	220.740 MHz
220.620 MHz	220.760 MHz
220.640 MHz	220.780 MHz

NOTE: The first ten of these channels could be paired with frequencies 1.6 MHz higher to provide full-duplex digipeaters. One suggestion would place inputs between 222.12 and 222.30 MHz and outputs between 220.52 and 220.70 MHz. The remaining four frequencies (220.72 thru 220.78 MHz) would remain simplex.

Four coordinated 9600 baud channels for packet linking:

220.825 MHz	220.925 MHz
220.875 MHz	220.975 MHz

440 MHz

Just as both 1200 baud Simplex and 9600 baud linking channels are required on the 220 MHz band, so are they required on the 440 MHz band. 440 is the only band with both readily available equip-

ment and a large amount of relatively unused spectrum (at least in Ohio). This combination provides for the possibility of large multiple-input, multiple-user shared systems. These systems might take the form of a large time-shared system. Such a system could provide many benefits for the Amateur community. For example: large data bases (on-line Callbook(s), publication bibliographies, abstracts of articles), a conferencing facility, main-frame computer facilities. However, such a system could only exist with a very large user support base. Such a large user base implies large, simultaneous demands for connect time. The radio required by the user should be capable of other service (probably FM). The currently available radios cover only ten Megahertz (usually 440 - 450 MHz). This limits the choice of locating these frequencies.

Fourty 1200 baud Simplex and LAN frequencies

441.000 MHz	441.400 MHz	441.800 MHz
441.025 MHz	441.425 MHz	441.825 MHz
441.050 MHz	441.450 MHz	441.850 Mhz
441.075 MHz	441.475 MHz	441.875 MHz
441.100 MHz	441.500 MHz	441.900 MHz
441.125 MHz	441.525 MHz	441.925 MHz
441.150 MHz	441.550 MHz	441.950 MHz
441.175 MHz	441.575 MHz	441.975 MHz
441.200 MHz	441.600 MHz	
441.225 MHz	441.625 MHz	
441.250 MHz	441.650 MHz	
441.275 MHz	441.675 MHz	
441.300 MHz	441.700 MHz	
441.325 MHz	441.725 MHz	
441.350 MHz	441.750 MHz	
441.375 MHz	441.775 MHz	

A portion of these frequencies (perhaps 441,500 to 441.975 MHz) may be paired with frequencies up 5 MHz for duplex digipeater operation. Such pairing would need to be coordinated with repeater coordinating councils.

Twenty coordinated 50 KHz packet linking channels (430-431 MHz):

430.075 MHz	430.375 MHz	430.675 MHz
430.125 MHz	430.425 MHz	430.725 MHz
430.175 MHz	430.475 MHz	430.825 MHz
430.225 MHz	430.525 MHz	430.875 MHz
430.275 MHz	430.575 MHz	430.925 MHz
		430.975 MHz

As W4WWQ suggests in the October 16, 1985 issue of Gateway, the ARRL packet newsletter, he "...would like to encourage some thought into use of the 420-450 MHz band instead of the 220 MHz band for 9600-bps linking." In some parts of the country, good, inexpensive, surplus commercial RF equipment for the 450 MHz band is available. "It seems a mistake to overlook that older equipment that has been the cornerstone of public-safety communications for years." Much of that equipment is easily "broad-bandable," if for no other reason that much of it was originally wide-band FM gear. "Inexpensive" is an understatement, since much of it (even in solid state form) can be had for the asking at swaps throughout Michigan, Indiana, Illinois, and Ohio. Tighter beam-widths and higher antenna gain for similar physical size of antenna at 430 MHz than 220 MHz also would make it easier to coordinate links in such a way that mutual interference would be minimal.

The TAPR NNC will have four ports, allowing most digipeaters to link in different compass directions or to a BBS. Each port would have to be outfitted with over $350 worth of 220 MHz Hamtronics boards, crystals, boxes and amplifier to deliver between 10 watts output per link. Multiply this times four, and each digipeater would be looking at $1400 to link in each compass direction, or $700 in a straight line, excluding antenna/feedline costs. Many older UHF transceivers that can generate 10 watts can be had for $15 to $35, allowing (after conversion costs) for linking in the four directions for under $200, again excluding antenna/feedline costs. FADCA beta testers of the K9NG modem and Hamtronics boards who have shared their reactions on CompuServe, have been less than enthusiastic about the feasibility of Hamtronics boards for this kind of service.

In the case of proposals for the 220 and 440 MHz bands, no one knows exactly what will happen as packet technology developes. Perhaps 19.2 Kbaud will be chosen as the standard data rate for linking or the 9600 baud modem designs will require channels more than 50 KHz wide. In such event, pairs of the 50 KHZ assignments can "stacked" together to create 100KHz wide channels. This proposal is made at a time when the final state of the art has not yet begun to appear. As such it must be viewed as it is, an attempt to provide a

structure for growth without providing any restriction on that growth. These "channels" are for guidance and comparison purposes.

Acknowledgement

I would like to thank those from whom I "borrowed" ideas (and the words to express them): Jim Brooker, N1BE, Chairman of the PRISM (Michigan) Spectrum Planning Committee, GRAPES and FADCA.

TAPR THIRD PARTY PROPOSAL

The following document was filed by TAPR with the FCC on Feb.24 in response to the recent FCC Report and Order 85-105 pertaining to automatic control of packet radio systems operating at frequencies above 50 MHz. The credit for pulling this document together should go to Harold Price, NK6K with some of the various ideas and comments having been generated by WA7GXD, WB6YMH, W3VS and W3IWI. de Tom, W3IWI

February 24, 1986

Before the
Federal Communications Commission
Washington, DC 20554

In the matter of	)	
Amendment of Part 97 of the	)	PR Docket No. 85-105
Commission's Rules to permit	)	
automatic control of amateur	)	RM-4879
radio stations.	)	

PETITION FOR RECONSIDERATION

Filed by:
Tucson Amateur Packet Radio
P.O. Box 22888
Tucson, Arizona 85734

To the Commission:

Tucson Amateur Packet Radio, a club with international membership consisting of 1400 amateur packet radio enthusiasts which has coordinated the volunteer development of many of the major build- ing blocks of the existing amateur packet network, and whose members have contributed since 1981 in the development of packet radio hardware, software, and operating procedures, hereby submits this petition for reconsideration of the report and order on PR docket No. 85-105. Our comments are limited to activities and operation above 50 MHz, as 85-105 only addresses these frequencies.

Our reasons for requesting a reconsideration are:

1) The inclusion of third-party traffic limitations, given the current definition of third-party traffic, puts severe con- straints on the design and utilization of the developing packet radio network.

The questions that arise in the amateur packet community over this issue are mainly semantic ones, caused by attempting to force new technologies to fit the old definitions supplied by 97.3. The FCC has stated both at amateur gatherings and in the comments associated with several recent actions that it is in- terested in promoting computer assisted amateur communications and what is commonly referred to as COMPUTER-BASED MESSAGE SYSTEMS (CBMS), or Bulletin Board Systems (BBS). Bulletin Boards are central repositories of messages sent between two or more parties. The messages are stored for indefinite periods of time on the bulletin board until they have been read by all parties concerned. The messages are seldom sent on behalf of the control operator of the BBS itself, and that's where the third-party rules begin to cloud the issue.

By strict application of the current definition of third party traffic :

97.3(v) Third party Traffic. Amateur radio communication by or under the supervision of the control operator at an amateur radio station on behalf of anyone other than the control operator.

A digital BBS system under automatic control could not transmit messages stored on it that are not originated by or destined for the control operator of that BBS. This makes illegal the major purpose of the bulletin board system.

During the early development and on the air testing of packet radio message systems, amateurs have viewed the message relay device as a

This is a message received by N8AGS from WB9MJN via KJ8C BBS.

517 PY 2618 N8AGS WB9MJN KJ8C 860413 thanks for wmpra newsletter.
Via WB9MJN: 2878 From WB9MJN Rcvd 860411/1727z, Sent 860413/0812z

I recieved it the same day ur message was forwarded here. I have a plan, my own presonal plan, for 220. Although a full duplex band below the present one on 220 would be desirable, especially for high speed linking, say a 100 khz full duplex channel, there isn,t room for such a thing in the metropolitan areas. As to LAN full duplex channels, I don t see why they shouldn't be up on the high end of the band with all the other full duplex operations, just goto having the ARRL reprimand any coordinator that doesn t cooperate. Since metropolitan areas represent approximately 1/2 of the packeteers, they wouldn't be able to use PRISM or Ur bandplan. 221.8 to 225 is full duplex repaters here and in many urban areas around the U.S.. This arrangement fully ocupies that spectrum with full duplex channels, giving maximun efficiency. Many of the simplex channels have been coordinated away it these areas. With, such being the case for 1/2 the paketeers I suggest the following plan.

220.0 - 220.5 weak signal and narrow band modes(A.M.,SSB,SSTV,...etc)

220.5 - 221.0 wide band modes, 80 or 100 kc channels(Wide band packet linking, local digital video, stuf useing packet linking hardware for local high data rate applications)

220.1 - 221.08 two 9600 baud channels.

221.08 - 221.12 two 20 kc 1200 baud channels, expanding upwards as required by local areas.

221.12 - 221.6 (approximately) existing repeater links, phase out over long period of time to accommodate new users in packet and simplex as local conditions require.

221.6 - 221.8 new simplex band, 20 kc channels. expand downward as required by local numbers of simplex voice operators.

221.8 - 225.0 full duplex operations. eliminate coordination biases, so that packet,rtty,sstv, etc are allowed. in areas where no channel available, and no other system similar to a non voice system exists, use lotery to determine which voice system will be decoordinated to make room for new modes. many voice systems lay dormant, used by 2 or theree people. this is not in the common good. as it causes exploration of new technigues to languish and goes against the stated purpose layed down in the communications act of 1934's Purpose for the amatuer radio allocations

Again this is my feeling on the subject. It doens t represent capra's.

18094 Fruitport Road, Spring Lake, MI. 49456

1 March 86

PACKET COMMUNICATIONS BAND PLAN PROPOSAL
(Revision A)

A PROPOSAL FOR THE TWO METER BAND

The operation of all digital stations that operate in one of the following manners are eligible (not required) for coordination. The intent of this eligibility option is not to force an operator to coordinate, but to offer guidelines to operators that operate with equipment meeting one of these conditions. Operators who meet one of these standards should realize to obtain maximum possible insurance from being exposed to harmful interference they will have to be coordinated with the proper agency. The operators who have been operating for a period of time and choose not to coordinate, of course, may become a potential source of harmful interference to a new station who has obtained coordination through the proper agency. This in effect will make it desirable to coordinate.

Operating stations meeting one or more of the following criteria are eligible for coordination:

1. Digital repeaters that are in service 24 HRS/DAY
2. Digital repeaters that transmit more than 50 watts into the antenna
3. Digital repeaters that are Association or club sponsored
4. Digital repeaters that are BBS or Message Box/File oriented
5. Digital repeaters with an antenna elevation greater than 100 feet above average terrain.

The following lower two meter band frequencies should be approved for Digital Communications. All of these frequencies will be implemented as determined by the local areas needs.

144.910	Experimental and QRP
144.930	Local Area Network
144.950	Local Area Network
144.970	Local Area Network
144.990	Packet Simplex
145.010	LAN and National Inter LAN/mail forwarding
145.030	Local Area Network
145.050	Local Area Network
145.070	Local Area Network
145.090	Experimental

The following upper two meter band frequencies are required for combining multiple frequency operations on one antenna which requires .600 MHZ minimum of separation. For Example, a packet station on 147.555 and another on 145.010 duplexed into the same antenna. The 145.010 for thru traffic and the 147.555 for BBS and LAN traffic. This type of separation is a must and eliminates the necessity of the users and operator to buy expensive additional gear to support a LAN, BBS and thru Traffic at the same sight. With a little additional work the existing voice machines could even work on the same antenna and feed line.

The following upper two meter band frequencies should be approved as coordinated 15 KHZ channels for digital communications.

147.525	Local Area Network
147.555	Local Area network
147.585	Local Area Network

NOTE: These frequencies will be converted to the following when the 20 Khz band plan is put into effect:

147.540	Local Area Network
147.560	Local Area network
147.580	Local Area Network

All frequencies that are assigned to a coordinated sponsor will be subject, upon request, to recoordination if the user does not have an operation "on the air" in 6 months.

Leonard A Todd, N8AGS

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Portion B offers the following (28) 20 Khz single channels:

1.) 220.740	10.) 220.920	20.) 221.120
2.) 220.760	11.) 220.940	21.) 221.140
3.) 220.780	12.) 220.960	22.) 221.160
4.) 220.800	13.) 220.980	23.) 221.180
5.) 220.820	14.) 221.000	24.) 221.200
6.) 220.840	15.) 221.020	25.) 221.220
7.) 220.860	16.) 221.040	26.) 221.240
8.) 220.880	17.) 221.060	27.) 221.260
9.) 220.900	18.) 221.080	28.) 221.280
	19.) 221.100	

Possible uses include:

1.) coordinated stations
2.) end users
3.) control frequencies
4.) two consecutive channels could be combined to support single channel high speed operations

==========

Portion C offers the following potential:

two 50 Khz channels	and	one 100 Khz channel
1.) 221.325		1.) 221.400
2.) 221.475		

==========

Portion D offers the following (31) 20 Khz channels:

1.) 221.500	11.) 221.700	21.) 221.900	31.) 222.100
2.) 221.520	12.) 221.720	22.) 221.920	
3.) 221.540	13.) 221.740	23.) 221.940	
4.) 221.560	14.) 221.760	24.) 221.960	
5.) 221.580	15.) 221.780	25.) 221.980	
6.) 221.600	16.) 221.800	26.) 222.000	
7.) 221.620	17.) 221.820	27.) 222.020	
8.) 221.640	18.) 221.840	28.) 222.040	
9.) 221.660	19.) 221.860	29.) 222.060	
10.) 331.680	20.) 221.880	30.) 222.080	

Possible uses include:

1.) coordinated stations
2.) end users
3.) control frequencies
4.) two consecutive channels could be combined to support single channel high speed operations

LEN TODD, N8AGS
WMPRA
TX 616-842-2340

The below band plan proposal reflects a plan that meets all the PRISM and WMPRA concerns. Look it over and drop me a line on the BBS or TX# 616-739-6525. I would like to take this to Dayton and be able to say "This is what we want to do!"

A 220 MHZ PACKET SUB-BAND PROPOSAL

PORTION A	PORTION B	PORTION C	PORTION D	PORTION E
220.52-220.72	220.74-221.28	221.300 to 221.300	221.52-222.10	222.12-222.32

The proposed usage of these portions are as follows:

PORTION A	PORTION B	PORTION C	PORTION D	PORTION E
(11) 20 Khz 1.6 Mhz paired channels	(29) 20 Khz single channels	(1) 100 (2) 50 Khz channels	(31) 20 Khz single channels	(11) 20 Khz 1.6 Mhz paired channels
INPUT Freq				OUTPUT Freq

Portions A and E offer the following frequency pairs:

	INPUT	OUTPUT
1.)	220.520	222.120
2.)	220.540	222.140
3.)	220.560	222.160
4.)	220.580	222.180
5.)	220.600	222.200
6.)	220.620	222.220
7.)	220.640	222.240
8.)	220.660	222.260
9.)	220.680	222.280
10.)	220.700	222.300
11.)	220.720	222.320

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THOUGHTS TO PONDER:

QUESTION: WILL FUTURE TRENDS LEAN TOWARDS:

1. HIGHER BAUD RATES?
2. DUAL FREQUENCY OPERATIONS (DUPLEX)?
3. A COMBINATION OF BOTH?

DISCUSSION: 9600 bits/second does calculate out to be quite a bit faster than the current standard of 1200 baud. Also, transmitting the necessary traffic to support packet communications on two frequencies has the potential to increase throughput by a 2.3 to 1 factor. Higher baud rates or double frequency consumption? What will be the trend of the future? I can surely see some potential sight specific RF problems coming for the sights that operated a NNC with four ports. ½If four ports were ran in duplex mode 8 operating frequencies would be needed at the same sight! Even running just simplex a minimum 4 simplex frequencies will be needed. What will be the harmonics generated at that sight? Is it desirable to keep the number of operating frequencies to a minimum and increase throughput with increased baud rate instead of doubling the spectrum absorbed at each sight? How far do we think 11 pairs of 220 mhz spectrum will go to meet the needs of these duplex operations? It is obvious that the answers will soon be found with the TAPR NNC coming off the drawing board. The above band plan would protect all the possible duplex pairs and still not significantly limit the number of single channels available. ½Even if the single channels were used and the trend appeared to veer away from duplex operations, the remaining pairs could be split to support more simplex operations. The plan above offers the flexibility to best meet which ever trend becomes reality! All the single channels are located between the spectrum planned for duplex usage.

QUESTION: WHAT IS THE PURPOSE OF THE WIDE BAND CHANNELS IN PORTION C?

DISCUSSION: These wide band channels are proposed for High Speed operations. As the speed goes up, more band width is used. For example, 9600 B/S has the potential to absorb 40 Khz of band width on this 220 Mhz band. The trend to lean towards 9600 B/S is already there. The technology will soon approach that speed. So, we must allow space for these type of operations.

QUESTION: What happens if we need more than two wide band channels for 9600 B/S?

DISCUSSION: Any two consecutive channels in Portion B or D could be combined to support 9600 B/S.

QUESTION: WHY DO WE NEED A 100 KHZ CHANNEL?

DISCUSSION: As technology catches up with current desires, baud rates will tend to exceed 9600 B/S. The 100 Khz channel will offer a testing ground for these experimental wide banded operations. Remember, as speed goes up, bandwidth increases!

QUESTION: WHY NOT USE 220.570 or 220.520 for high speed linking. The other clubs has [indicated] a wish to make those "national" high speed frequencies.

DISCUSSION: Using 220.520 or 220.570 for high speed linking would cause not only one possible duplex pair to be absorbed by that operation, but two! 9600 B/S linking will need up to 40 Khz of bandwidth. That would require two 20 Khz channels. To do this operation in Portion A of the spectrum would reduce the already limited numbers of possible pairs to 9. Yet, this operation could be done in portions B, C or D without impacting the limited number of potential duplex pairs! The frequencies in Portion C (221.325 and 221.475) are just as available and in this plan are proposed for that use.

QUESTION: WHY PUT THE THREE WIDE BAND FREQUENCIES IN THE MIDDLE OF THE SINGLE CHANNEL SPECTRUM?

DISCUSSION: These three frequencies were put in the middle of the single channel band to give the coordinators a starting point for coordination of the single channels. It was offered as a suggestion that the coordinations the simplex channels start at the edges of Portions B and D next to Portion C. They would then work towards the Portions A and E. This way of implementing the spectrum would allow them to preserves all possible split pairs for duplex operations until the last moment. If the trend was to progress to simplex operations and all the potential channels in Portions B and D were used and if there were duplex channels not used in portions A or E, then the edge of portion B could be extended into portion A. this would only be possible if Portion A was allocated from it's beginning of 220.520 towards Portion B. If you really look at it close, the location of the wide banded operations doesn't really matter since it does not fall in Portions A or E! This method is only one of the possible ways to implement the band.

Closing Comments:

If you really look at this close, you will find that the PRISM proposal for the duplex frequencies are in this plan. This plan also directs that a portion of the band be dedicated to high speed operations which was a concern of PTG and WMPRA. All the PAC have agreed on using this [portion] of the band to support a packet sub-band, right? Also, there is no mention of limiting mode or rate in here. It assumed current technology will determine that. In actuality the coordinations asked for could be determined entirely by the local area's needs, which seemed to be what most the PAC wanted.

If you have any comments or questions, please feel to contact me. If you have suggestions for changes or find an error please send them when possible. I would like to hear from you about this proposal. It has not yet been endorsed by WMPRA. I guess I am asking, can you endorse this proposal? Does it still need work? If it needs changes or corrections, please let me know what they are so I can go back to the PAC for approval with the Asn's recommendations!

Len Todd, N8AGS
18094 Fruitport Road
Spring Lake, MI 49456

The below band plan proposal reflects a plan that meets all the PRISM and WMPRA concerns. Look it over and drop me a line on the BBS or TX# 616-739-6525. I would like to take this to Dayton and be able to say "This is what we want to do!"

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Portions A and E offer the following frequency pairs:

	INPUT	OUTPUT
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2.)	220.540	222.140
3.)	220.560	222.160
4.)	220.580	222.180
5.)	220.600	222.200
6.)	220.620	222.220
7.)	220.640	222.240
8.)	220.660	222.260
9.)	220.680	222.280
10.)	220.700	222.300
11.)	220.720	222.320

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2.) 220.760	11.) 220.940	21.) 221.140
3.) 220.780	12.) 220.960	22.) 221.160
4.) 220.800	13.) 220.980	23.) 221.180
5.) 220.820	14.) 221.000	24.) 221.200
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5.) 221.580	15.) 221.780	25.) 221.980	
6.) 221.600	16.) 221.800	26.) 222.000	
7.) 221.620	17.) 221.820	27.) 222.020	
8.) 221.640	18.) 221.840	28.) 222.040	
9.) 221.660	19.) 221.860	29.) 222.060	
10.) 331.680	20.) 221.880	30.) 222.080	

Possible uses include:

1.) coordinated stations
2.) end users
3.) control frequencies
4.) two consecutive channels could be combined to support single channel high speed operations

Len Todd

LEN TODD, N8AGS
WMPRA
TX 616-842-2340

==========

THOUGHTS TO PONDER:

QUESTION: WILL FUTURE TRENDS LEAN TOWARDS:

1. HIGHER BAUD RATES?
2. DUAL FREQUENCY OPERATIONS' (DUPLEX)?
3. A COMBINATION OF BOTH?

DISCUSSION: 9600 bits/second does calculate out to be quite a bit faster than the current standard of 1200 baud. Also, transmitting the necessary traffic to support packet communications on two frequencies has the potential to increase throughput by a 2.3 to 1 factor. Higher baud rates or double frequency consumption? What will be the trend of the future? I can surely see some potential sight specific RF problems coming for the sights that operated a NNC with four ports. If four ports were ran in duplex mode 8 operating frequencies would be needed at the same sight! Even running just simplex a minimum 4 simplex frequencies will be needed. What will be the harmonics generated at that sight? Is it desirable to keep the number of operating frequencies to a minimum and increase throughput with increased baud rate instead of doubling the spectrum absorbed at each sight? How far do we think 11 pairs of 220 mhz spectrum will go to meet the needs of these duplex operations? It is obvious that the answers will soon be found with the TAPR NNC coming off the drawing board. The above band plan would protect all the possible duplex pairs and still not significantly limit the number of single channels available. Even if the single channels were used and the trend appeared to veer away from duplex operations, the remaining pairs could be split to support more simplex operations. The plan above offers the flexibility to best meet which ever trend becomes reality! All the single channels are located between the spectrum planned for duplex usage.

QUESTION: WHAT IS THE PURPOSE OF THE WIDE BAND CHANNELS IN PORTION C?

DISCUSSION: These wide band channels are proposed for High Speed operations. As the speed goes up, more band width is used. For example, 9600 B/S has the potential to absorb 40 Khz of band width on this 220 Mhz band. The trend to lean towards 9600 B/S is already there. The technology will soon approach that speed. So, we must allow space for these type of operations.

QUESTION: What happens if we need more than two wide band channels for 9600 B/S?

DISCUSSION: Any two consecutive channels in Portion B or D could be combined to support 9600 B/S.

QUESTION: WHY DO WE NEED A 100 KHZ CHANNEL?

DISCUSSION: As technology catches up with current desires, baud rates will tend to exceed 9600 B/S. The 100 Khz channel will offer a testing ground for these experimental wide banded operations. Remember, as speed goes up, bandwidth increases!

QUESTION: WHY NOT USE 220.570 or 220.520 for high speed linking. The other clubs have indicated a wish to make those "national" high speed frequencies.

DISCUSSION: Using 220.520 or 220.570 for high speed linking would cause not only one possible duplex pair to be absorbed by that operation, but two! 9600 B/S linking will need up to 40 Khz of bandwidth. That would require two 20 Khz channels. To do this operation in Portion A of the spectrum would reduce the already limited numbers of possible pairs to 9. Yet, this operation could be done in portions B, C or D without impacting the limited number of potential duplex pairs! The frequencies in Portion C (221.325 and 221.475) are just as available and in this plan are proposed for that use.

QUESTION: WHY PUT THE THREE WIDE BAND FREQUENCIES IN THE MIDDLE OF THE SINGLE CHANNEL SPECTRUM?

DISCUSSION: These three frequencies were put in the middle of the single channel band to give the coordinators a starting point for coordination of the single channels. It was offered as a suggestion that the coordinations the simplex channels start at the edges of Portions B and D next to Portion C. They would then work towards the Portions A and E. This way of implementing the spectrum would allow them to preserves all possible split pairs for duplex operations until the last moment. If the trend was to progress to simplex operations and all the potential channels in Portions B and D were used and if there were duplex channels not used in portions A or E, then the edge of portion B could be extended into portion A. this would only be possible if Portion A was allocated from it's beginning of 220.520 towards Portion B. If you really look at it close, the location of the wide banded operations doesn't really matter since it does not fall in Portions A or E! This method is only one of the possible ways to implement the band.

Closing Comments:

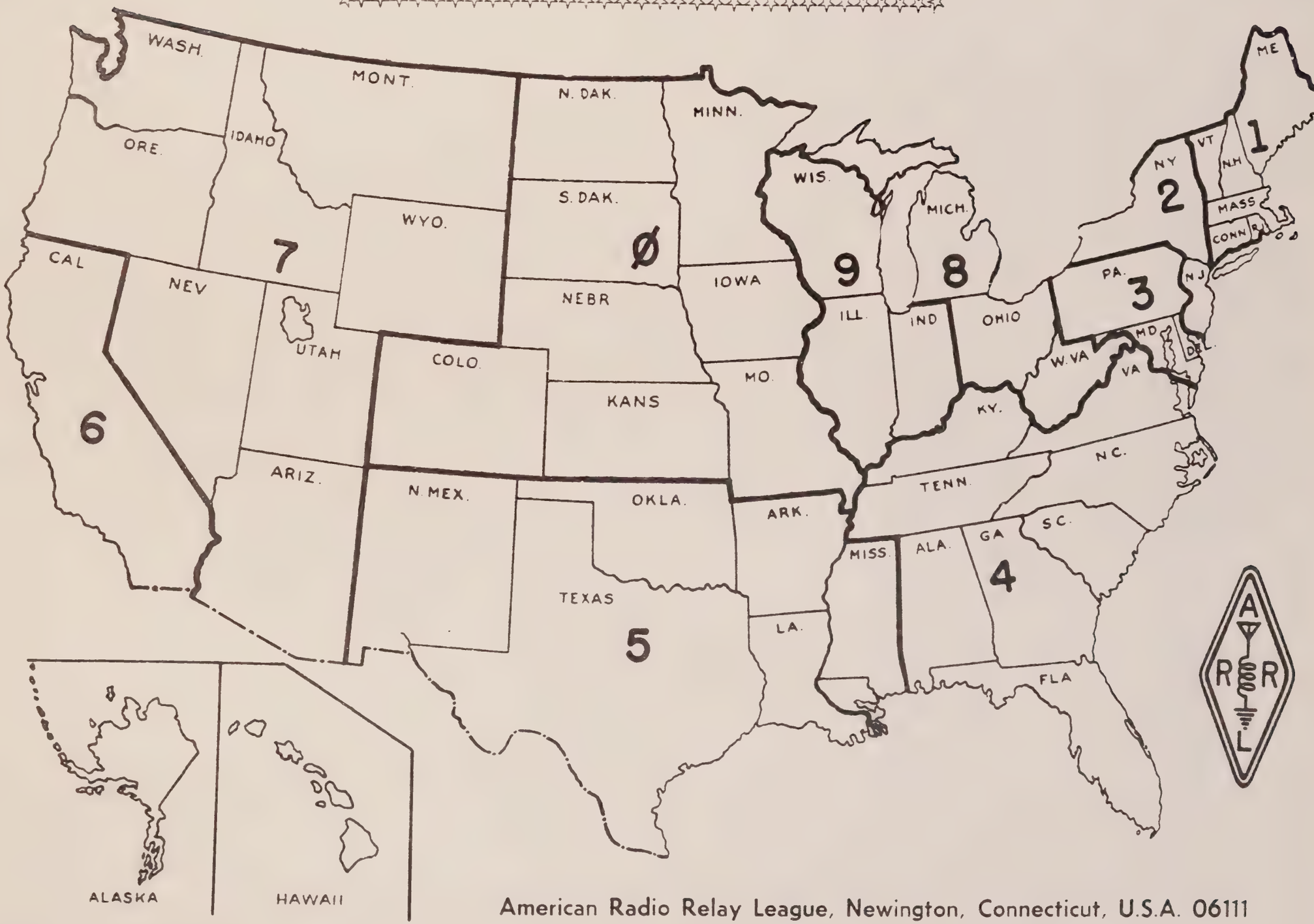
If you really look at this close, you will find that the PRISM proposal for the duplex frequencies are in this plan. This plan also directs that a portion of the band be dedicated to high speed operations which was a concern of PTG and WMPRA. All the PAC have agreed on using this [portion] of the band to support a packet sub-band, right? Also, there is no mention of limiting mode or rate in here. It assumed current technology will determine that. In actuality the coordinations asked for could be determined entirely by the local area's needs, which seemed to be what most the PAC wanted.

If you have any comments or questions, please feel to contact me. If you have suggestions for changes or find an error please send them when possible. I would like to hear from you about this proposal. It has not yet been endorsed by WMPRA. I guess I am asking, can you endorse this proposal? Does it still need work? If it needs changes or corrections, please let me know what they are so I can go back to the PAC for approval with the Asn's recommendations!

Len Todd

Len Todd, N8AGS
18094 Fruitport Road
Spring Lake, MI 49456

ARRL WAS MAP



American Radio Relay League, Newington, Connecticut, U.S.A. 06111

CD-222

```
Msg# TR  Size  To     From    @ BBS  Date     Title
5260 PY   383 K1ZZ   W0RLI          860408 w9zrx
Via W0RLI: 173 From W0RLI Rcvd 860406/0115z, Sent 860408/0738z
KE1G # 7869 in 860401/0332z, out 860406/0117z
Via N1DKF: 4967 From W0RLI Rcvd 860330/2158z, Sent 860401/0321z
Via W0RLI: 8839 From W0RLI Rcvd 860330/2013z, Sent 860330/2157z
Via W0RLI: 9930 From W0RLI Rcvd 860330/1842z, Sent 860330/2014z
```

w9zrx/would like to be included in any
HF auto operation STA ...

... Hank

```
Msg# TR  Size  To     From    @ BBS  Date     Title
5259 PY   425 K1ZZ   W0RLI          860408 wb7dch
Via W0RLI: 174 From W0RLI Rcvd 860406/0115z, Sent 860408/0736z
KE1G # 7857 in 860330/1201z, out 860406/0118z
Via N1DKF: 4947 From W0RLI Rcvd 860330/0529z, Sent 860330/1152z
Via W0RLI: 8819 From W0RLI Rcvd 860330/0435z, Sent 860330/0529z
Via W0RLI: 9906 From W0RLI Rcvd 860330/0116z, Sent 860330/0435z
```

Just got a note from wb7dch indicating
he would be interested in taking part
in any HF auto-operation STA.

... Hank

```
Msg# TR  Size  To     From    @ BBS  Date      Title
5258 PY  4063 K1ZZ    W0RLI          860408 FYI
Via W0RLI: 175 From W0RLI Rcvd 860406/0117z, Sent 860408/0726z
KE1G # 7856 in 860330/1200z, out 860406/0118z
Via N1DKF: 4948 From W0RLI Rcvd 860330/0534z, Sent 860330/1144z
Via W0RLI: 8818 From W0RLI Rcvd 860330/0434z, Sent 860330/0530z
Via W0RLI: 9915 From W0[illegible] Rcvd 860330/0432z, Sent 860330/0433z

  This is a list of HF GateWay / BBS stations
  as seen from w0rli, Westford, Mass.
  I believe that I am aware of all currently
  active HF BBS, but it is possible there
  exist others. I have left out those stations
  in countries with which we have no 3rd
  party agreement.

  List as of 3/29/86

n1dl,   Sudbury, ma  (145.09 / 14.105 GateWay)
  Currently active.
  (Backup link into New England. Testing with europe and "dx")
wb1dsw, E. Kingston, nh  (145.01/14.103 GateWay)
  Currently active.
  (New England link, shared with w0rli)
wa1lrl, Brighton, mi  (VHF/14.107 GateWay)
  Currently active.
  (Sole link into MI, backup into OH/ve3/W9)
wa2ftc-1, Newington, ct  (145.01 / 14.107 GateWay)
  Status not known.
kc2tn, Atco, nj  (HF/VHF GateWay)
  Status not known.
w3tmz, Mount Airy, md (HF/VHF GateWay)
  Status not known.
k3wpz, Granite, md  (HF/VHF GateWay)
  Status not known.
k4aho, Orlando, fl  (HF/VHF GateWay)
  Not heard several months, assume inactive.
k4eid, Knoxville, tn  (HF/VHF GateWay)
  Currently active.
  (Sole link into TN)
kf4jf, Hahira, ga  (VHF/14.107 GateWay)
  Not heard recently.
k4nta, Stuart, fl  (VHF/14.107 GateWay)
  Currently active.
  (Shared with k4tku, FL link)
wa4szk, Florence, sc  (HF/VHF GateWay)
  Currently active.
  (Sole link into SC/NC/AL)
k4tku, Miami, fl  (HF/VHF GateWay)
  Currently active.
  (shared with k4nta, FL link)
ki4xo, Marietta, ga  (VHF / 14.107 GateWay)
  Currently active.
  (Primary link into GA)
n5edh, Camp Verde, az  (VHF / 14.107 GateWay)
  Currently active.
```

28
wtte-tv

Adel
JOE SUBICH
CHIEF ENGINEER

6830 SUNBURY RD., PO BOX 280 • COLUMBUS, OH 43216 • (614) 895-2800

(Primary link to Arizona network)
wd5gaz, Houston, tx (HF/VHF GateWay)
Not heard several months.
w5xo, Gause, tx (VHF / 14.107 GateWay)
Currently active.
(Sole link to Texas network)
ni6a-1, Richmond, ca (VHF / HF GateWay)
Currently active.
(Northern CA link)
kd6sq, Rancho Cucamonga, ca (HF/VHF GateWay)
Currently active, part time.
(Southern CA link)
ke7cz, Dewey, az (HF/VHF GateWay)
Not heard this month.
(secondary AZ link)
wb7dch, Enumclaw, wa (HF/VHF GateWay)
Currently active.
(Sole link into NW coast network, including ve7)
k7pyk, Scottsdale, az (VHF / 14.107 GateWay)
Not heard this month.
kb8ci, Cleveland, oh (VHF / 14.107 GateWay)
Status not known.
ad8i, Circleville, oh (VHF / HF GateWay)
Currently active.
(Primary link into OH)
wb8lvp, Poland, oh (VHF/14.103 GateWay)
Not heard recently.
ni9d, Brookfield, wi (VHF / 14.107 GateWay)
Currently active.
(Primary link into WI, secondary into IL/IN)
w9zrx, Westfield, in (VHF / HF GateWay)
Currently active.
(Primary link all W9)
k0hoa, Colorado Springs, co (VHF / 14.103 GateWay)
Currently active.
(Secondary link into CO)
ki0q, Ames, ia (HF/VHF GateWay)
Currently active.
(Sole link into IA / NE)
kc0qj, Walsenburg, co (VHF / 14.107 GateWay)
Currently active.
(Primary link into CO network)
w0rli, Westford, ma (145.07 / 14.107 GateWay)
Currently active.
(New England link, see wb1dsw)
ve3gyq, London, on (VHF / 14.107 GateWay)
Currently active.
(Sole link into ve3, backup into MI/OH networks)

The VHF network as seen from the East Coast extends From Montreal and Ottawa to Wash. D.C, and to Pittsburgh and Western NY. There are links on VHF that extend into all of W8 and W9, but they are of low reliability at this time. The southern part of this network (refered to as Eastnet) extends into WVA and most of VA, but does not yet have reliable links through the Carolinas and points south.

The most obvious missing links are to KH6 and KL7. At this time, none exist.

Hope this information is useful. Will continue to observe the HF packet BBS operations and keep abreast of existing links. Let me know when you would like an update.

... Hank

Msg# TR Size To   From   @ BBS Date   Title
5257 Y 2656 K1ZZ KI4XO   860408 STA
Via W0RLI: 176 From KI4XO Rcvd 860406/0118z, Sent 860408/0722z
KE1G # 7833 in 860329/1731z, out 860406/0120z
Via W0RLI: 9877 From KI4XO Rcvd 860329/1436z, Sent 860329/1720z
Via KI4XO: 245 From KI4XO Rcvd 860328/2243z, Sent 860329/1401z
 244 N 1928 K1ZZ KI4XO   860328 Hello Dave
Just read your message on Hank's BBS and I have a vested interest in the unattended and automated packet operation on HF. I am extremely glad to recieve the notice that you are considering co-ordinating the efforts to achieve the STA. While it is nice of you to do, that I have some relevant issues with the FCC since I am involved as being one of the orginal stations monitored by Mr. Larabee from the Maine FCC monitoring station. Lets just say it has become a matter of principle with me. At the present I am and have been on HF packet BBS operations for quite some time. (over 1 and 1/2 years). I have operation data for propagation and paths etc... stored in my files and hundreds of user's data. While not currently the biggest station on the air I have handle over 3500 messages while operating HF and VHF. This also includes the VHF to HF gateway mode which I have recently avoided turning on here since it is unclear to me of the operation of technicians via my station on the HF bands is a feature or a potential problem.

What I have done for the past several months is manually handle the HF to VHF traffic in a supervised store & forward mode.

I am currenly involved in the Kaypro Bios modifications and this message arrive to you from the Kaypro 10X system I run here with a couple of hard disks and a 5" floppy. Dan KE7CZ is the principle architect of the bios conversion efforts while I have focused on getting some of the later models features to work.

What is desired is to be allowed to participate in the future events and planning with you and the ARRL . My conversations with Perry Williams have lead me to believe that you would like to encourage the development of the hobby and I am voluntering my station and services to do so. I have access to equipment and am willing to dedicate it to these ends of achieving automated and computer supervised store and forward switches on the ham bands. I left you a phone message and my address. I will give it to you again so that we may talk on this matter.

John Smith
2449 Old Forge Court
Marietta, Ga. 30062
phone 404-641-1576 home
404 956-2303 work

Please don't hesistate to call me, as I will be calling you Monday. You can always reach me on 14.107 direct or through Hank W0RLI HF store and forward system. Thanks for your time.

Regards.
John

Msg# TR Size To   From   @ BBS Date   Title
5186 PY   79[illegible] W0RLI W1AW   860407 HF STA
Via WA2FTC: 333 From W0RLI Rcvd 86[illegible]6/0701z, Sent 860407/1424z
Via W0RLI: 149 From W0RLI Rcvd 860406/0106z, Sent 860406/0700z
KE1G # 7841 in 860330/0211z, out 860406/0109z
Via W0RLI: 8785 From W0RLI Rc[illegible] 860329/1428z, Sent 860330/0203z

If such an STA comes to pass,
I'm willing to collect and analyze the log files
from all participating stations. From this analysis
we can determine a large amount of useful information
including message loading, on-air times, average
connect time per connection, etc. etc.

NEPRA will discuss the STA at it's next meeting
(April 10) - and will forward the results of
the discussion to you. I believe we (NEPRA) should
be closely involved, since we have the largest
number of HF BBS stations with the longest history
of HF BBS operation...

... Hank

PR

April 29, 1986

Andrew W. Trecborn, WØCCZ
5??? Borrego Dr.
Colorado Springs, CO 8091?

Dear Andy:

Thanks for your letter, nominating Dave Shavey, KØHOA, to be one of the recipients of an HF packet STA.

This is exactly the kind of input we had hoped to receive!

Paul Rinaldo is putting together a coordinated list, with the objective of having a draft filing ready for review during May. We may need some additional information from Dave, in which case we'll contact him directly.

Thanks again for being part of the solution to what we hope will be a temporary problem in packet development.

73,

Sincerely,

David Sumner, K1ZZ
Executive Vice President

DS:ja

Andrew W. Freeborn
NØCCZ
5222 Borrego Drive
Colorado Springs CO
80918

23 April 1986

1986 APR 28 AM 11:20

Mr. David Sumner K1ZZ
Executive Vice President
ARRL
225 Main Street
Newington CT 06111

Dear Dave,

I have just become aware of the proposed STA for automatic control of packet-radio operations, via "It Seems to Us...", QST, May 1986.

I am delighted to see the aggressive action of the ARRL in nurturing the mode through this still infantile packet radio era.

My purpose in writing is to present the need for one of the STA's in the Rocky Mountain Region and to make a specific recommendatioin.

We have a digipeater operating at 14,110 feet (MSL) immediately to the west of Colorado Springs (NØCCZ-1 on Pikes Peak). It has been operating for two years. The coverage of this digipeater is from Cheyenne WY on the north, to western Kansas on the east, and to the New Mexico border on the south (approximate area covered in this eastern quadrant is 35,000 sq. miles). To the west, when links are installed this summer, we expect to have good coverage of most of western Colorado.

Dave Shavey, KØHOA, has submitted a request to be considered as one of the HF Gateway STA's.

He operated a very active HF Gateway prior to 85-105. His Gateway served as a valuable East-West relay point at that time. Today he operates a VHF PBBS on 145.01 and 145.09. He is dedicated to, and enthusiastic about the potential of packet radio message handling. His direct access to the wide area digipeater, and the widespread VHF network that it serves, makes his station a very desirable location for one of the STA's.

I trust that the ARRL STA selection process will favorably consider the needs of this region and the specific capabilities of this already proven station and operator.

Happy Packeteering and 73

Andy

April 22, 1985

TO: David Sumner K1ZZ
FROM: Dave Shavey KOHOA
SUBJECT: Special Temporary Authorizations

I would like to request that this Gateway, KOHOA, be taken into consideration for a Special Temporary Authorization with the league's Executive Committee for automatic control of packet-radio operations.

At the present time the Gateway is being operated on 145.01 and 145.09, and the 145.09 is shifted to HF when Im home. I have had the Gateway on the air for 8 months and have been averaging 400 to 500 messages per month, about 35% being HF.

My background in packet starts with the beta-board, packet demonstrations, packet field-day 1985 and packet at the Pikes Peak Hill Climb Race 1985.

The Gateway is centrally located on the front range and at the present time all traffic is relayed thru this Gateway north to Cheyenne, Wyoming, south to Trinidad, Colorado and east to Cheyenne Wells, Colorado. A digi is planned for Burlington, Colorado this summer which will link us to Kansas and into Nebraska. Another digi is also being researched to link us to the west with Durango and Grand Junction, Colorado.

When the Gateway was on HF 24 hours per/day it was very active and capable of being a relay PBBS from the east to the west during these unfavorable band conditions. My station is equipped for packet with back-ups on all equipment and is capable of running high power, if needed, for good comunications

I have NTS experience and was one of the first to commit the Gateway for NTS traffic for all of Colorado with Hank, WORLI.

I have a CO-SYSOP, retired military, who can check 3rd party traffic before it would be forwarded when I am not present. The PBBS has a forwarding file which prevents 3rd party traffic forwarding until changed by SYSOP or CO-SYSOP.

If there is any question you have that I have left unanswered please feel free to call collect (303) 598-1508 at home or (303) 634-3742 at work. If a reference is needed contact Andy Freeborn, NOCCZ, 5222 Borrego Drive, Colorado Springs, Co. 80918.

Respectively,

Dave Shavey, KOHOA
4745 Nightingale Drive
Colorado Springs, Co. 80907

RECEIVED
A.R.R.L. #6
1986 MAY -5 AM 10:42

7071 Montana Ave.
Rancho Cucamonga, CA 91730
29 April 1986

Mr. Paul Rinaldo W4RI
ARRL
225 Main St.
Newington, CT 06111

In reference to conversations with Harold Price NK6K and the authorization by the Executive Comitte to solicit candidates for operation of packet stations under automatic control at frequencies below 50 Mhz., I respectfully request to be considered as a candidate for such operation.

During the period from May 1985 thru March 1986 I operated a VHF to HF gateway in the southern California area on 14.103 Mhz. The station operated with the digipeat function diabled and only a store and forward mode on HF with a power of approximately 80 watts to a 3 element 8 Db gain beam. The VHF coverage covers the Los Angeles Basin and south to San Diego and north to Santa Barbara and on several ocassions provided links to San Francisco. The station handled an average of approximately 150 messages per month, including NTS traffic and AMSAT orbit data and bulletins.

Equipment used in the gateway operation was as follows:

Xerox 820-1 computer w/ 8 inch disk drives
running WØRLI gateway software
Kenwood TS-430S tranceiver
Kenwood TW-4000 VHF/UHF tranceiver
TAPR TNC-1
Heath HD-4040

Additionally an IBM PC clone is available with compatible software written by WA7MRL

At the present time the station is undergoing modification and has not been operating in the gateway mode since early March. I feel that the store and forward capability is the primary mode that should be explored on the HF frequencies and that the use of lower power greatly reduces the effectiveness of the mode of operation by reducing the "hidden terminal" effects, which seem to be associated with high power operation on packet. I have been able to maintain effective communications with WØRLI and N1DL using only 80 watts and scheduling to use prime propagation periods.

Additionally due to packet BBS systems operation on a common HF frequency I often found anomalies in normal propagation patterns, such as several 20 meter openings on trans-continental paths 5 to six hours after local sunset when propagation normally deteriorates.

I would like to participate in the STA in hopes of opening this mode of operation on packet so that we might establish a functional network, an invaluable asset for the amateur radio community for emergency communications both on a local and national level, and to assist in making the technological advances which packet radio has brought to amateur radio continue so that we might attract the young people of today to our hobby.

It is though these youngsters of the computer age who have not been told that it can't be done that the amateur radio community can continue to provide benifits to the advance of technology and service to our communities and the nation.

Sincerely,

John J. Eigenbrode

John J Eigenbrode KD6SQ

May 9, 1986

Donald Simon, NI6A
2327 Alva Ave
El Cerrito, CA 94530

Dear Don:

Thank you for your letter.

We're still in the "receive mode" on stations for the packet-radio STA. Your recommendation is in the hat. It will be a couple more weeks before we come up with a list of those stations making the best geographical pattern.

You went into a lot of detail on who might have said what in connection with PR Docket No. 85-105. I'm not sure that it's worth going over that bit of history with a fine-tooth comb; you're bound to find some anomalies in any brief summary (such as the EC minutes or the Partial Opposition) of anything this complex. Suffice it to say that President Price and the others who assisted him did their homework, read signals we received from the FCC accurately, and obtained the best result practicable. In order for the FCC to deal with the above-30 MHz issue (that's what was on the table under 85-105), it became necessary to isolate the matter of automatic operation below 30 MHz. Considering everything, the below-30 MHz issue was best dealt with through the STA route so the FCC could get on with 85-105. Appropriate as they may have been, had the Petitions for Reconsideration filed by ARRL and others been the only action taken, we'd still be dead in the water while they were digested and disposed of.

73,

Paul L. Rinaldo, W4RI
Chairman, Ad Hoc Committee on
Amateur Radio Digital Communication

PLR/cs

Paul Rinaldo, W4RI
ARRL
Newington, Ct. 06111

April 30,1986
2327 Alva Ave.
El Cerrito, Ca. 94530

Dear Paul,

This letter is primarily in response to the announcement by David Sumner in the May, 1986 issue of "QST" regarding the executive board having authorized the staff to solicit candidates for automatic control on hf based on the need of geographical coverage. Since 16 out of the 20 petitions for reconsideration regarding PR Docket Nr 85-105 were from the San Francisco Bay area; and since we have been operating Northern California's only HF/VHF Gateway mailbox we hope that our experience, reliability, and location will be helpful to the purposes of the STA. We would like to apply for W6CUS-1 which runs a Xerox 820 computer, a 10 MB hard disk, an Icom 280 on VHF, an Icom 735 on HF with TAPR TNCs. W6CUS is the callsign of the East Bay Amateur Radio Club, which is an ARRL affiliated club. It is also jointly sponsored by the East Bay Packet Radio Association, West Contra Costa County ARES, and the American Red Cross. It is located at 3200 MacDonald Blvd at the Richmond Red Cross Annex B, Richmond, Cal. It served in the Northern California Floods of 1986 as the central clearinghouse for over 150 Official Red Cross DWI messages (see May "World Radio News". It is linked on VHF to the following WORLI mailbox systems: AA4RE-1 (Gilroy-Garlic Valley Packet Society) , N6IIU-1 (Palo Alto Red Cross), WA6NWE-1 (Sacramento ARES/RACES).

Currently the HF port is off the air as we are building a second independent 440 MHZ control link so that we can have control operators monitor and turn off the HF port independently of the VHF port (when the HF control operators are off duty). Our current remote control system resets the tncs and mailbox automaticly. We have auto boot proms installed on the Xerox 820 to boot up the hard drive. The existing tone decoder can take only one output/input; but we hope to have a 16 I/O card operating within 2 weeks. In the meanwhile, we are installing NI6A-1 at my house with a second XEROX 820 gateway system to do the automatic store and forwarding when W6CUS-1 is down. We have both the technical experience and dedication to see through the STA and I hope you will chose stations with this in mind.

Frequencies and Power

As you might remember, we communicated about six months ago about HF packet frequency coordination. I am glad to see that the ARRl is now willing to take this on. I hope you will be sensitive to the fact that a good frequency on the East Coast amy not be suitable here on the West Coast and vice versa. One of my primary concerns having been STM here for 5 years and a traffic handler for over 25 years, is that 3630 KHZ has been designated by many East Coast packeteers as a 80 M packet frequency. This would not

be suitable here as 3630 KHZ is the net frequency for the Northern California Net (the Section net of the East Bay, San Jaoquin, Santa Clara, Sacramento, and San Francisco ARRL Sections). This net meets at 1900 and 2030 hours local time daily and such interference from a national packet system would probably be disconcerting. I have monitired 3642 KHZ and find it clear here on the West Coast and according to the Net Directory, it is a realtively clear frequency; and I therefore suggest that as the frequency for 80 M packet. Let me say that 80 M is excellent in the winter for late night and early morning packet reliability, something that a national system desires. I am certain we could do national forwarding at 0900 UTC from the West Coast to a BBS in the Central area and then to the East Coast with very good reliability. The advantage is that 80 M is almost empty at 0900 UTC and there is no DX or contesters around 3642 KHZ. It seems that there should be no complaints using this method.

I have had considerable experience on 40 M HF packet. W6CUS-1 was forwarding on 7093 KHZ with W9ZRX, AD8I, N5EDH, KC0QJ, W5XO, KE7CZ, and others before we temporarily shut down last month. 7093 KHZ gives the distinct advantage of short skip during the day and long skip at night so that the mailbox can forward to different regions depending on the propagation. 7093 KHZ is free of foreign broadcast stations here as well as on the East Coast. Another advantage to 40 M and 80 M is that it is much less likely to be abused by foreign stations and much less likely to cause interference to DX stations as both bands are less used than 20 Meters. I would like to put W6CUS-1 on 7093 KHZ and NI6A-1 on 3642 KHZ if that was acceptable to your over all plan. I propose that we run 100 watts output to dipoles (thereby even further minimizing the chance to interference.

I suggest the 10 MHZ band to be also better than 20 M, but with the warning that the MUF will drop below both 20 M and 30 M this winter consistently past 1900 PST; and it will be therefore unusable for aproximately 12 hours a day (the times when everyone is asleep is when the band is least crowded and the least interference is created). Personally I don't think we need to use 20 M and above especially because of QRM and propagation unreliability factors. The store and forward systems on the lower frequencies may be able to do the job as well or better. However I have no objection to others using 20 M, 15 M and 10 M frequencies and mailboxes if you so chose.

How Many Participants?

It was not clear in the article by David Sumner whether the ARRL is proposing 15 experimental stations total or 15 per band. I suggest 15 per band as 15 total would given we are talking about at least 4 bands, would not be much of an experiment given the vagaries of propagation. Although your intent is to experiment with interference problems primarily, I would like to see the system set up in as much of a realistic manner as possible, so we can actually see how this may interface for the NTS and the

Red Cross during overload periods and/or disasters. Without 15 participants per band we will not have the suitable propagation conditions most of the time to check out the system in a loaded situation.

To Clear the Air

I realize that the ARRL STA is the result of a motion brought up by director Wilson at the executive meeting, however may I present some thoughts to you at this time in the hope that it will clear the air (or at least get some weight off my chest). After reading the executive board minutes and the official ARRL Partial Opposition to Petitions for Recconsidertaion, I would like to point out to you, the ARRL Staff, and director Wilson that it was not correct to infer that the petitions of KI4XO, AJ6T, WD6CMU, N6BAH, and NI6A implied or suggested "blanket authorization for automatic control of digital communications on HF frequencies" as has been stated by the ARRL atorney and staff on more than one occasion. Although not having read the KI4XO petition the other petitioners mentioned made it very clear that automatic control on HF should be permitted only when certain devices were installed and procedures instituted to prevent certain possible abuses. Some of these petitions went into great detail on the nature of these hardware and software controls (please see the petition of WD6CMU and NI6A for instance). It seemed rather inconsistent to members here why this inaccurate interpretation was taken by director Wilson and such an opposition petition filed.

Previously, I was planning to file for a STA on behalf of the East Bay Packet Radio Association in such regard before I read the ARRL position. I'd rather have you do the bookwork, if it is going to be done at all. I would appreciate you getting back to me asap, as to the possibilities of W6CUS-1 and NI6A-1 being suitable candidates for this STA. I agree that such a controlled experiment (or series thereof) should be performed with accurate automatic logkeeping and reliable participants. I suggest that perhaps a period of 6 months may be a suitable time period for the STA as opposed to one year.

Thanks for all your efforts.

73,
Donald Simon

Donald Simon, NI6A
AD Pacific Divison (Packet/NTS)
Net Manager NCN/PACKET (NTS)
Communication's Chairman,
Berkeley/West Contra Costa
American Red Cross.

CC: KA6M
KB6ZV
WD6CMU
AJ6T
W46YL

5/28/86

Paul Rinaldo
c/o ARRL
225 Main St.
Newington, Ct. 06111

Dear Paul,

It was nice chatting with you in Dayton this year. As you may remember (or may not with 24,000 hams around) I was talking to you about obtaining one of the STA's for HF packet operation.

I have currently been on packet for three years now and was one of the first HF gateway/PBBS's on the East coast. I presently run a PBBS in Southern N.J. on 145.03 and gateway to 20 meters for forwarding into the ever growing national network. I feel it is imperitive to organize all the existing HF PBBS' to make the most efficient use of channel space and resources. Hopefully with the authorization of these STA's we will be able to prove to the FCC how we Hams can responsibly utilize a new technology to it's fullest capacity.

Although I am not sure where the status of the HF packet STA project stands I would like to again let you know that I am still interested in participating in this endeavor. I have been an Amateur operator for 20 years and currently hold an Advanced class license. I maintain state of the art equipment for both HF and VHF communications. My packet equipment consists of two TAPR tnc-1's and one AEA tnc-2. The PBBS is a xerox 820 running the WORLI software. If I can be of any assistance to get automatic forwarding and increased Baud rates authorized for the Ham bands please let me know. Currently I am the only HF gateway station operating in New Jersey for forwarding mail into the network.

Thank-you in advance for your help. You can reach me by phone at 609-768-0822 after 6PM or at 609-772-9956 during the day at my work location. My home address is 33 Oakwood La., Atco, N.J. 08004.

Sincerely,

Joseph A. Fisher
KC2TN

531 Victoria Av
Belleville
Ontario K8N 2G6
Canada

...ived
A.R.R.L. HQ

31 May 1986

1986 JUN 11 AM 11:07

Chairman,
Digital Committee,
ARRL HQ,
225 Main St,
Newington,
CT 06111
U.S.A.

Dear Sir,

This letter is with reference to the notice that appeared in League Lines in the May issue of QST.

I would like to provide input to the AD Hoc Committee on Amateur Radio Digital Communication. Currently I am working in the area of the generation of graphics, images etc using NAPLPS the North American Presentation Level Protocol Syntax and conducting experimental work transmitting these pictures using Packet Radio.

I am interested in making a contribution towards developing an amateur standard which describes the requirements for NAPLPS.

My current project is to complete an article for QST which describes my experiments with picture transmission by Packet Radio.

At this time there are quite a few amateurs interested in this aspect of the hobby. I sense the possibility of a groundswell which could contribute to the Packet Radio Revolution. I feel that any advances should be guided by the sensible and timely use of appropriate standards.

I am looking foreward to hearing from you.

Very truly yours,

Syd Horne VE3EGO
Technical Coordinator CRRL Ontario

Proposal to the ARRL packet protocol committee. G. Boelke, W2EUP

RECEIVED
A.R.R.L. MAY 05 1986

The purpose of this proposal is to request the committee to reserve a single value for the PID byte in the AX.25 protocol. No effort has been made to formalize byte or bit assignments at this point. If the committee finds sufficient interest I'll generate a more detailed proposal.

The first use for this byte is to provide means for one TNC to request identification of the make, model and program version of another TNC. This capability would make it possible for the calling TNC to adapt its protocol responses to the callee, avoiding problems for users. The implementation of a response to such a request is left as an option to the TNC designer. If no response is received operation would simply proceed as it does at present.

It's unrealistic to assume that all future protocol implementations are going to be identical and perfect. Suppose somebody comes out with TNC in large numbers, that has a protocol error or misinterpretation, and either cannot or will not issue corrective updates. If it identifies itself other TNC's could be programmed to work around the problem.

Besides the basic purpose of self-identification, some other uses for the same special PID come to mind. It may take experimentation to reveal their value. Even then I think compliance should be optional, although if an option is widely exercised it would be useful to standardize methods of requesting and responding to it. Note that only ONE PID value is proposed for these ideas. The byte following it would further specify what feature is being accessed, whether it is a request or a response, etc.

2. Set turnaround delay. Much channel time is wasted on preambles of excessive length; in fact it may be the single biggest channel-time-waster. To avoid the nuisance of changing delays for every connection, most users set it long enough for the slowest stations. The sender specifies the amount of time required for his station to turn around and the recipient TNC sets its preamble length to suit. The change applies only for the duration of a connection. Such a feature already exists in the GLB CPK program and it has proven to be a useful feature, but fully automatic operation would be much better.

3. Request date/time. A main digipeater or gateway with a clock/calendar could provide a date/time reference on request ("synchronize watches"?).

4. Request alternate channel. On connecting, two TNC's could confer automatically (perhaps based on current observed channel loading) and 'agree' to switch to another radio channel. If no response is heard on the new channel within a specified period they would both return and (perhaps) try again. When the connection terminates both stations would automatically return to the original channel.

5. Request geographical position. This information could be useful to guide the selection of digipeaters as implemented in the present level 2. A broader application of this idea might be to request general information on the other station, such as location, handle, equipment, etc. This feature would probably be used by operator command rather than automatically by the calling TNC. A TNC could be provided with a buffer for such information, typed in by the operator.

6. A lead-in to specialized TNC features. The byte(s) following could be interpreted as an entry to other features that the maker of a TNC might want to provide, not necessarily under the control of any committee standards. If the identification of the TNC says brand X, and brand X has a remotely-accessible command structure, this would be the means to access it. This feature would not necessarily be limited to TNC's; the TNC could pass such requests to the host system, where users can put their imaginations to work.

2. That the results of the technical committee study of the interference problem shows that they should be encouraged in forceful terms to meet with the committee to resolve both problems.

3. Failure to meet with the committee might result in WA2EXP/R receiving a letter of de-coordination at the next General meeting.

14. Ceasar, N1DCS, Dick, KB1H, and John, K3ZJJ, as Connecticut directors, reported on the problem with Dick, WA1YQE, who has apparently raised his power to the point where his interference to KA2BCD is quite high, and they reported that an interference complaint had also been received from K2MFF/R in Jersey City, New Jersey. They recommended that the Council send Dick a certified/return request letter inviting him to the next General meeting.

5. Gary, WA2BAU, reported that Pete Madson, K2PM, trustee of the WA2GWA repeater on 146.85 MHz in Frenchtown, New Jersey, was having problems with Bob Reed, WB2DIN, who had moved nearby from Long Island and continued using the W2VL repeater on 146.85 MHz causing problems for the Frenchtown repeater. Pete requested that TSARC take some type of action. After discussion the board felt that this was a problem of a user, and did not represent an area for TSARC to work in.

6. Gordon, N2DSY, reported on the actions of the packet radio sub-committee. He recommends that the sub-committee consist of:

Norman, W2JUF Gordon, N2DSY Tom, W2VY Gary, WA2BAU John, K3ZJJ
Paul, WB2VUK Harold, KB2M Paul, AD7I Alex, AI2Q Emil, WA2UPK
Doug, WB2KMY

The first task of the committee should be to take a look at part 97 with a view towards adding or subtracting sections necessary to enhance the growth of packet into the 1990s. The final draft of revisions would then be circulated to other groups involved in packet in other parts of the country with a final view towards recommendations to the FCC when all that wanted to had a chance to "sign off" on the recommendations. This was seen as a long term project. In the short term the sub-committee was asked to report on a regular basis with any recommendations they might have for spectrum allocations, or standards to be propagated.

. John, K3ZJJ, discussed the on-going problem between K1IJJ and K1XR. After working out a solution at a negotiation meeting the Keene, NH, group has decided not to honor the agreement reached.
MOTION: (K3ZJJ/KB1H) That it is resolved that it is our recommendation that the agreement reached at Mount Washusetts should be fully implemented by both parties before further action is considered by the Council. Passed unanimously.

. The DATE FOR THE ANNUAL MEETING WAS SET FOR --> MAY 31, 1986 AT 10 AM
The PLACE FOR THE ANNUAL MEETING WILL BE ----->

. There being no further business, the Board adjourned at 11:15 PM.

A Standard for Digital Transmission of SSTV via Packet Radio

Preliminary 22 Apr 86

This is a proposal for error free digital SSTV transmitted via packet radio. Picture information from a standard TV camera is converted to digital form by a digital scan converter. Packet radio may then be used to move that information from one scan converter to another. The advantages of using packet radio for the transfer are its inherent error-free communications and store-and-forward abilities. The received packets may be sent to the memory of another scan converter at the destination or (with some degradation) displayed by a personal computer.

The problem to be overcome with this concept is the vast amount of data in a picture. At present data rates, it would require much too long to send an entire 34 or 36 second frame of high resolution SSTV at a pixel per byte. However, as recently shown by the Voyager II spacecraft at its encounter with Uranus, video information may often be represented by fewer bits than one pixel per byte. This preliminary standard presents a method of 'data compression' which substantially reduces the number of bits necessary to transmit a SSTV picture. Please note that the method described herein does not degrade the picture but formats (slowly changing) digitally represented video data for more efficient transmission. This method is also applicable to reducing the amount of data storage space required to save pictures in RAM or on disk

A standard * has been proposed by which digital data other than text messages may be sent via packet radio. Using this or a similar standard, three identifying items of information must be transmitted in each packet. These items are: Category, Type and Level. The Category is SSTV for data to be exchanged between digital scan converters. The Type may be one of several which may be defined at this time (see table 1). Standard 8.5 second B/W, 8.5 second sequential color or 36 second composite color are examples of Type. Level refers to the specific set of data reduction modes which must be implemented in the receiving system to reproduce the picture. Described herein are a minimum of modes necessary for effective data reduction of two fundamental SSTV standards. They are designated Level 0 and Level 1.

Level 0 and Level 1 SSTV data compression techniques consist of three message types called compression modes (CM) plus necessary sync bytes. Level 0 indicates SSTV data represented by six bits per pixel. Level 1 indicates data represented by eight bits per pixel. As new compression modes are added the level must be changed so that the receiving equipment can determine if it is capable of displaying the data. The following description assumes Level 0 unless otherwise noted. Refer to table 2 for specific bit patterns for the mode messages.

A group of CM messages is assembled into a 256 byte packet for transmission via packet radio. Because the CM messages do not necessarily begin and end on byte boundaries, the packets must be transmitted in the 'transparent' mode used for binary data. CM messages are of various lengths and are placed end to end crossing byte boundaries as required.

Compression mode 0 (absolute CM) encodes one pixel in one byte and consists of two mode ID bits and six bits representing the actual pixel value. (For Level 1, eight bits are used to represent a pixel, a total of ten bits are required.) Once a pixel is defined remaining pixels of that line may have the same value (fill) or be represented by their difference from the pixel preceding them.

Compression mode 1 is the fill CM. Substantial data reduction results from this CM that 'copies' or fills n pixels with the same value as the previous pixel. A CM 1 message consists of four bits of ID and eight bits of pixel count n.

Compression mode 2 is the differential CM and includes four bits of ID, six bits representing the number (n) of pixels following and n three bit groups representing n pixels as the difference from the previous pixel.

Each line begins with the horizontal sync byte and at least one pixel value sent in absolute CM form. The remaining pixels of that line may be represented by any CM.

Sync bytes are one byte each for vertical sync, horizontal sync and frame complete. For the different types of color SSTV a sync byte may be used to define the particular type of color frame or color data that follows.

Receiving

The technique of determining the current pixel's value from the previous pixel's value plus the transmitted value is quite easy to 'decode' in the receiving computer. Each line begins with the horizontal sync byte and an absolute (CM 0) pixel value. The receiving computer is connected between the TNC and the scan converter picture memory. As each pixel is reconstructed, it is sent to the scan converter for display at the fast scan rate.

The receiving software is somewhat less complicated than the transmitting software. Several 'correct' representations of a picture line exist. At the receiver any of these representations may be used to reconstruct the picture. The only difference may be their relative efficiency (fewer bits sent per line). This efficiency is not a concern of the receiving software. The only requirement for the receiving software is that it be of or above the Level of the transmitted data.

Transmitting

The more computing intensive portion of the system is in encoding the the data. As long as the picture is properly encoded it will be displayed at the receiver properly. The maximum 'data compression' is a separate issue and involves encoding the data into its most compact form. Maximum compaction requires an encoding algorithm that finds the best combinations of compression modes to match the data. Finding this algo-

rithm becomes more complex as more CMs are added to achieve the maximum compression possible for a reasonable complexity of software. Table 3 shows formulas for finding the number of data bytes necessary to represent n pixel values.

Experiments

The purpose of this proposed standard is to promote experimentation in the field of SSTV via Packet Radio. The authors solicit comments, suggestions and experiment reports.

* 'A Standard for Identification of Digital Data via Packet Radio', K.O. Learner,II K9PVW, 26 Mar 1986, attached.

K.O. Learner, II K9PVW and Steven H. Rogers P.O. Box 5014 Kokomo, IN 46902 packets via W9ZRX (HF/VHF), K9OPO for hand delivery

Table 1

Types of SSTV Formats

Type	Description	
0	8.5 s	B/W
1	8.5 s	RGB color
2	12 s	composite color
3	17 s	B/W
4	17 s	RGB color
5	24 s	B/W
6	24 s	composite color
7	34 s	B/W
8	34 s	RGB color
9	34 s	composite color
A	36 s	B/W
B	36 s	composite color
C	72 s	composite color

Table 2

Mode Messages for Level 0 and Level 1 SSTV

Category: SSTV Type: see Table 1 Level: 0 (6 bit data)
1 (8 bit data)

CM	Description	Message
0	1 pixel, absolute	00vv vvvv
0	or 1 pixel, absolute	00vv vvvv vv
1	1-256 pixels, fill	0100 nnnn nnnn
2	1-64 pixels, +/- 3 relative	0101 nnnn nnvv vvvv vvvvvv
3	undefined	0110
4	undefined	0111
5	undefined	1000
6	undefined	1001
7	undefined	1010
8	undefined	1011
9	undefined	1100
10	undefined	1101
11	undefined	1110
12 A	Frame Complete	1111 0000
12 B thru 12 H are undefined		
12 I	Luminance	1111 1000
12 J	Red	1111 1001
12 K	Green	1111 1010
12 L	Blue	1111 1011
12 M	C2 Sync	1111 1100
12 N	C1 Sync	1111 1101
12 O	Hz Sync	1111 1110
12 P	Vt Sync	1111 1111

Notes = Compression Mode

CM 0 Stores 1 pixel of value v (6 or 8 bits)

1 Stores n+1 pixels of value = previous pixel
0 <= n <= 255

2 Stores n+1 pixels having varying values which are represented by 3 bit values coded in 2s compliment format to be added to the previous pixel's value
0 <= n <= 63

Frame End	indicates end of a frame
Luminance	indicates L data follows
Red	indicates Red data follows
Green	indicates Green data follows
Blue	indicates Blue data follows
C2 Sync	indicates C2 color info follows (Robot 1200C)
C1 Sync	indicates C1 color info follows (Robot 1200C)
Hz Sync	indicates start of a new line
Vt Sync	indicates start of a new frame

Table 3

Mode	Description	Data Spaces (bytes)
0	1 pixel, absolutel (6 bits)	1.25 (8 bits)
1	n pixels, fill	1.5
2	n pixels, +/-3 rel.	3/8(n-2) +2

A Standard for Identification of Digital Data via Packet Radio

Preliminary 26 Mar 86

Packet Radio has grown very quickly in recent months and a nationwide network will soon be a reality. All forms of communications will benefit from transmission via digital techniques. For example, digital encoding of voice information or SSTV for transmission via packet is on the horizon.

Because digital data is 'hidden' from humans, a computer readable identification must be included with the non-ASCII data to allow 'reading the mail'. An identification standard that will be universally applied is required.

The ID standard must allow for experimentation, as this is its primary reason for existence. Perhaps the detailed scheme could be similar to the FCC 'emissions type' definition.

Use of an agreed upon standard 'type' description allows a computer to receive the packets and determine the rules to 'display' the message to the user. This might mean the exact algorithm for reproducing a voice or SSTV message. The human could read the type of data by looking up the three 'type' data fields from a table if desired. It is very important to provide enough room in the definition scheme to allow descriptions to grow for many years.

A proposed Standard for ID of Digital Data via packet radio:

Three descriptors:

1.	Category	ie.	voice,	fax,	sstv,	icons,	wx images,	software	
2.	Type	ie.	LPC,	Std,	Robot 36s color,		Mac,	GOES,	Z80 asm
3.	Level	ie.	1,	2,	7,		4,	4,	3

Each descriptor is a one byte (binary) value

Category and Type could be defined early and the entries would not change, but could be added to.

Level would change with each new experimental representation of data.

A standard of this type must be defined by a group of packet experts and enforced in some manner. This is no small task, but would greatly increase the utility of packet radio experimentation.

K.O. Learner, II K9PVW P.O. Box 5014 Kokomo, IN 46902
Packets via W9ZRX HF/VHF to K9OPO for hand delivery.

PR:
What do you suggest?
Hold K.O.s material?
Haven't ack'd yet. Mat 6/11/86

RECEIVED
1986 JUN 11 AM 9:11

Mr. K.O. Learner,II K9PVW
P.O. Box 5014 Kokomo, IN 46902

Dear K.O.

I have read your two papers on standards (Ref 1,2) and think they address a very important area. This is an area that the community must come to grips with if we want to go forward into the digital world. I would like to address the two papers separately and try to put your work in a broader contex.

The first paper (Ref 1) is a good start. However it must be carried a step farther. First, packet radio is just one form of digital radio, and standards must be developed for all forms of digital radio transmission. I will grant you that packet is currently the most prevalent form, and standards for packet radio will provide the basis for standards in other modes of digital radio transmission.

I assume that you propose to include the three bytes of category, type, and level information in the structure of the packet and a human, or more importantly, a computer could interpret it and switch (automatically) to the correct protocol. I would like to see a similar concept used to identify the modulation and coding scheme. As signal processing chips become more ubiquitous, they will be used in RF modems and at baseband for error correction and detection. This will allow the modulation and coding to change dynamically during a transmission depending on the robustness of the channel and/or the spectrum efficiency required in the presence of real time channel loading. I envision a digital radio system where the transmission starts off with a very robust modulation and coding scheme (a basic standard) and changes to another modulation and coding (one of many standards) to overcome a badly fading HF channel or to a different (high-level) modulation and coding scheme (again a standard) to push a lot of bits through a narrow uhf channel. What you have proposed then would fit in since the control processor (and there will be one) could automatically assign the correct digital voice algorithm or fax or whatever. Your proposed standards are a good start in the right direction. We need a way they can be flagged automatically.

The second paper on digital transmission of SSTV is somewhat difficult for me to read as I have no experience on analog SSTV. For example, I don't understand what "a Robot type 36 second color picture" is. Possibly, many other potential readers have little or no experience in the analog systems. I also question the wisdom of tieing standards closely to the old analog SSTV as digital SSTV is a completely new world. It appears that you tied this approach to the ROBOT 1200 which I think is a mistake. I believe most amateurs will end up using their computers for digital SSTV. That is, a frame grabber will take the video image and store it in the computer. This data can then be compressed and I agree that compression is the only way to go for

digital SSTV. I would suggest that digital SSTV is closer to computer graphics than it is to the old analog SSTV.

I am unable to relate your tables to pixels. Perhaps I don"t understand, but in table 2, it looks like CM 1,2 & 3 perform different functions than the remainder. Perhaps it is the use of the phrase "CM". This needs clarification. Again, I can't tell if your compression scheme is general to an image stored in a computer or to the ROBOT 1200. What other commercial standards exist? Should Amateur radio be compatible with commercial group three fax systems?

We have a system in our office called DISCON which is made by the Interand Corporation of Chicago. It sends 640 by 480 pixels in RGB color digitially over dialup phone lines by a UDS 9600 v.29 modem. The new Photophone also looks very interesting in this regard and might have possibilities if the cost were to come down. I understand the Amega computer has a resolution similar to the DISCON and would appear to be useful as the heart of a digital SSTV system. I would think that you would need only a camera input with a frame-grabber or a scanner to get the image into the computer would and a modem of some type and you can be on the air. By the way, I have run the v.29 modem over FM radios over the INMARSAT satellite full duplex at 9600 baud. I would think we could also do it over amateur FM radios.

I don't have a bottom line for you. I think you have some good ideas, but before publication, they need to be put in a contex where they are easily understood . I hope I have given you some insight on the direction I think amateur radio should go in the digital world.

Please feel free to contact me on any of these subjects.

Sincerely

al

Al Dayton, KA4JFO

References

1. A Standard for Identification of Digital Data via Packet Radio.

2. A Standard for Digital Transmission of SSTV via Packet Radio.